US009055147B2

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Surace et al.

(10) **Patent No.: US 9,055,147 B2**
(45) **Date of Patent: Jun. 9, 2015**

(54) **VOICE USER INTERFACE WITH PERSONALITY**

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(21) Appl. No.: **11/848,958**

(22) Filed: **Aug. 31, 2007**

(65) **Prior Publication Data**

US 2008/0103777 A1 May 1, 2008

Related U.S. Application Data

(63) Continuation of application No. 11/314,002, filed on Dec. 22, 2005, now Pat. No. 7,266,499, which is a continuation of application No. 09/924,420, filed on Aug. 7, 2001, now Pat. No. 7,058,577, which is a continuation of application No. 09/654,174, filed on Sep. 1, 2000, now Pat. No. 6,334,103, which is a continuation of application No. 09/071,717, filed on May 1, 1998, now Pat. No. 6,144,938.

(51) **Int. Cl.**

G10L 21/00	(2013.01)
G10L 25/00	(2013.01)
G10L 15/00	(2013.01)
G10L 15/18	(2013.01)
G10L 13/00	(2006.01)
H04M 3/493	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H04M 3/4936*** (2013.01); ***G10L 13/033*** (2013.01); ***G10L 15/19*** (2013.01); ***G10L 15/22*** (2013.01); *H04M 3/487* (2013.01); ***H04M 3/493*** (2013.01); *H04M 3/53383* (2013.01); *H04M 2201/40* (2013.01); *H04M 2201/60* (2013.01); *H04M 2203/355* (2013.01)

(58) **Field of Classification Search**

USPC 704/257, 258, 200

See application file for complete search history.

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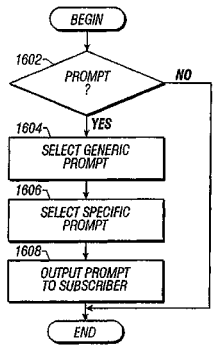
Primary Examiner — Olujimi Adesanya

(74) *Attorney, Agent, or Firm* — Sterne, Kessler, Goldstein & Fox P.L.L.C.

(57) **ABSTRACT**

The present invention provides a voice user interface with personality. In one embodiment, a method includes executing a voice user interface, and controlling the voice user interface to provide the voice user interface with a personality. The method includes selecting a prompt based on various context situations, such as a previously selected prompt and the user's experience with using the voice user interface.

18 Claims, 18 Drawing Sheets



(51) **Int. Cl.**

G10L 13/033	(2013.01)
G10L 15/19	(2013.01)
G10L 15/22	(2006.01)
H04M 3/487	(2006.01)
H04M 3/533	(2006.01)

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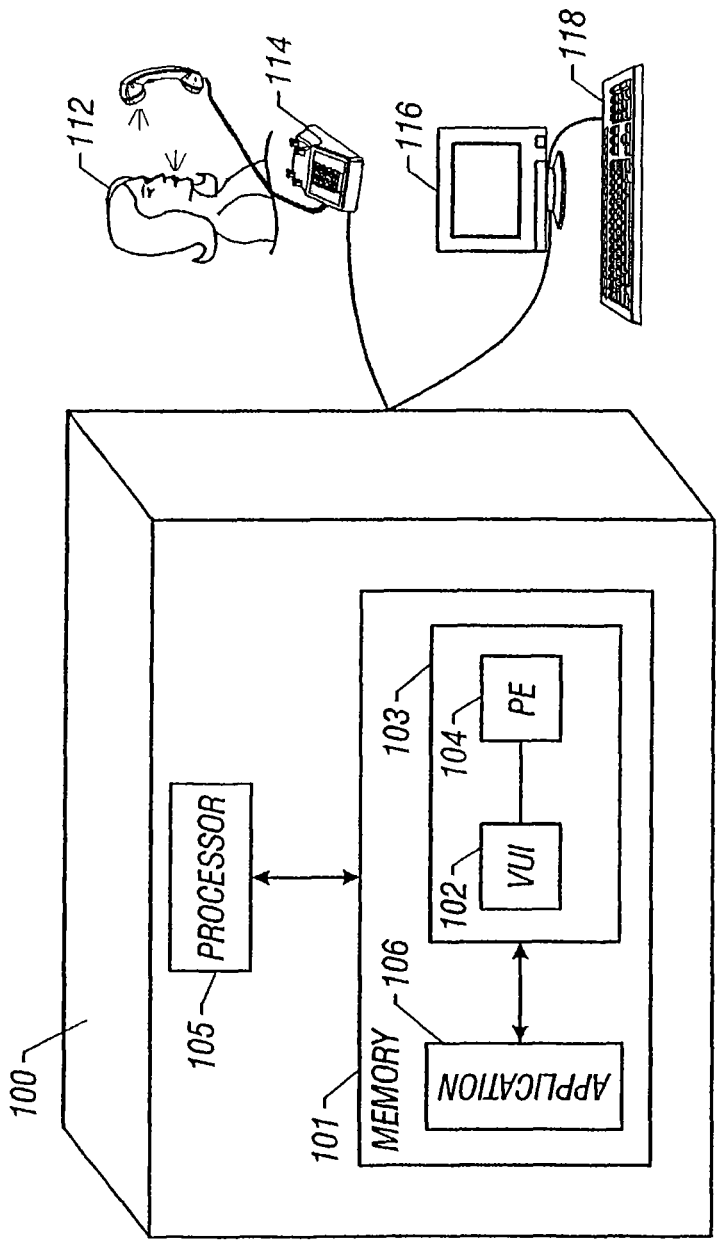

112
114
116
118
100
105
PROCESSOR
101
MEMORY
106
APPLICATION
102
VUI
103
104
PE

FIG. 1

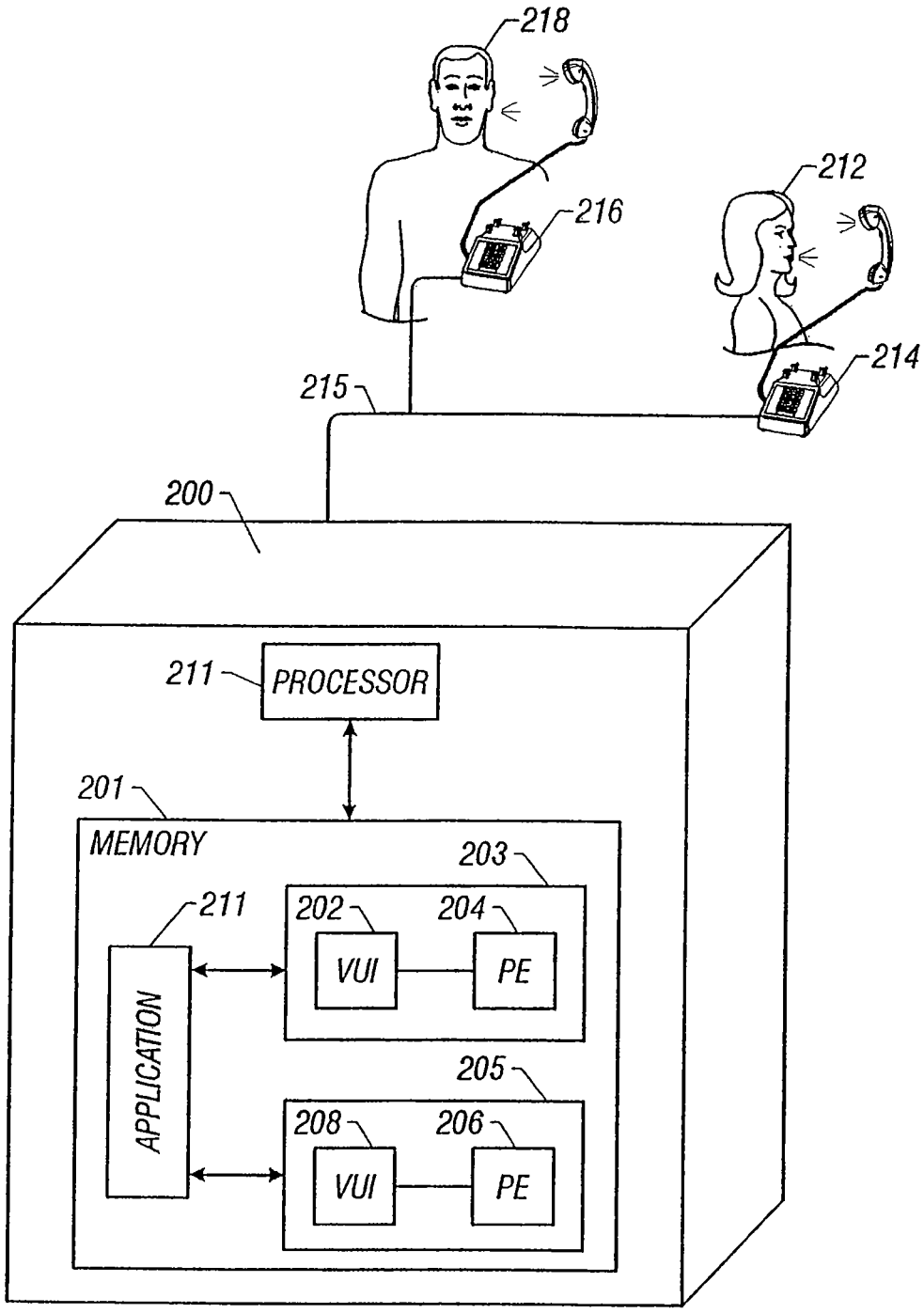

218
212
216
214
215
200
211
PROCESSOR
201
MEMORY
203
211
202
204
VUI
PE
APPLICATION
205
208
206
VUI
PE

FIG. 2

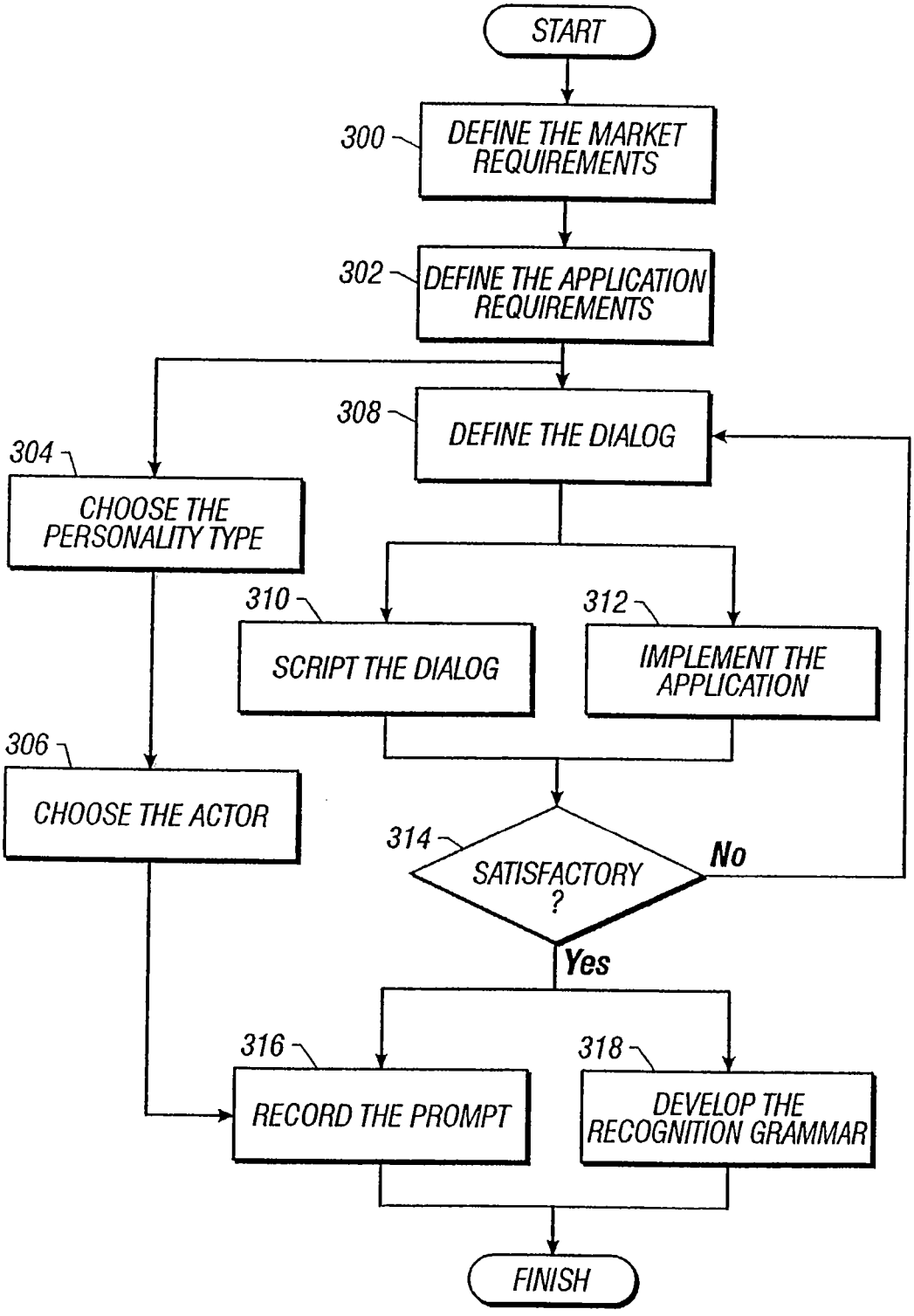

START
300
DEFINE THE MARKET REQUIREMENTS
302
DEFINE THE APPLICATION REQUIREMENTS
308
DEFINE THE DIALOG
304
CHOOSE THE PERSONALITY TYPE
310
SCRIPT THE DIALOG
312
IMPLEMENT THE APPLICATION
306
CHOOSE THE ACTOR
314
SATISFACTORY ?
No
Yes
316
RECORD THE PROMPT
318
DEVELOP THE RECOGNITION GRAMMAR
FINISH

FIG. 3

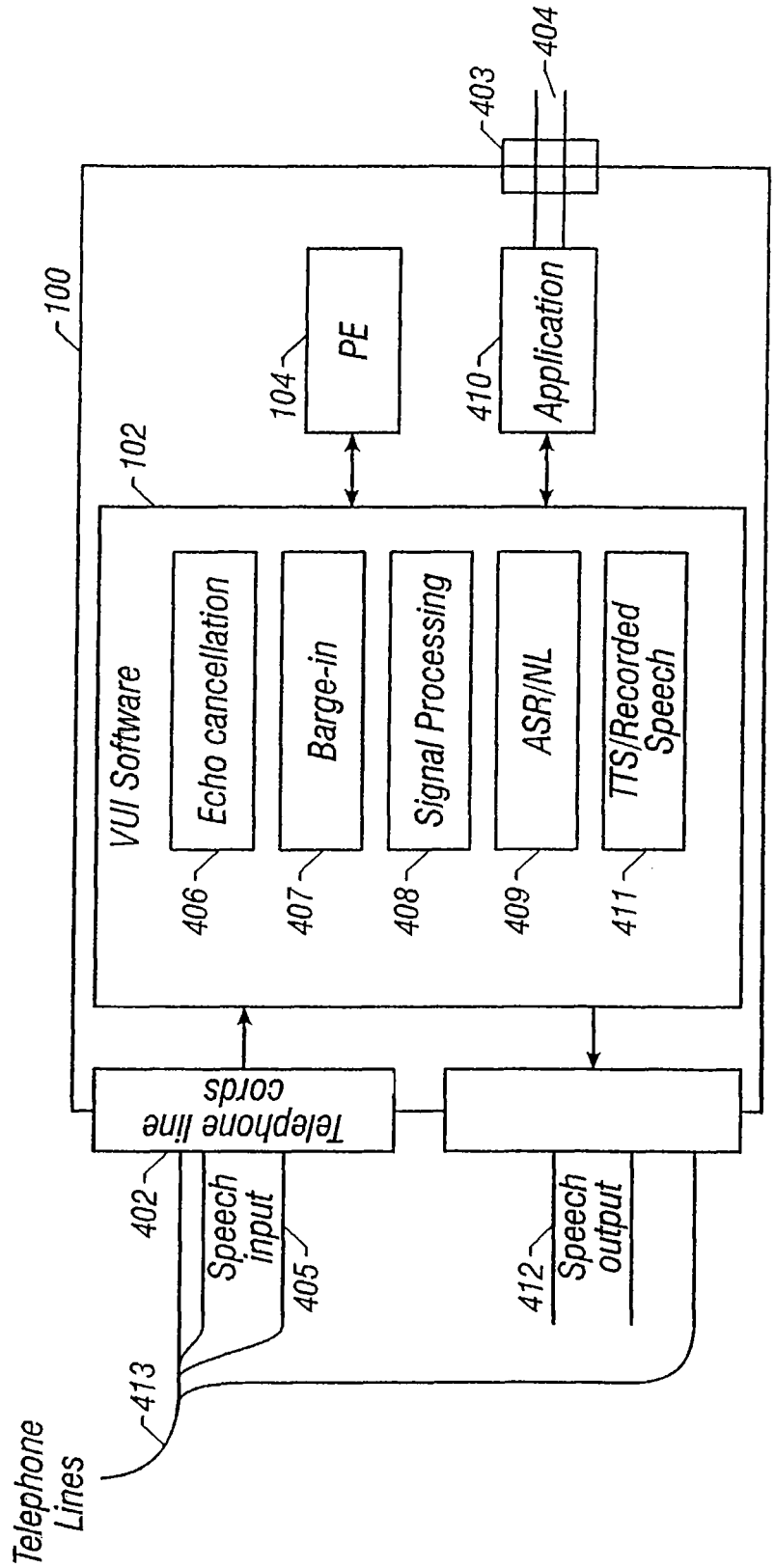

Telephone Lines
413
402
Speech input
405
412
Speech output
Telephone line cords
100
102
VUI Software
406
Echo cancellation
407
Barge-in
408
Signal Processing
409
ASR/NL
411
TTS/Recorded Speech
104
PE
410
Application
403
404

FIG. 4

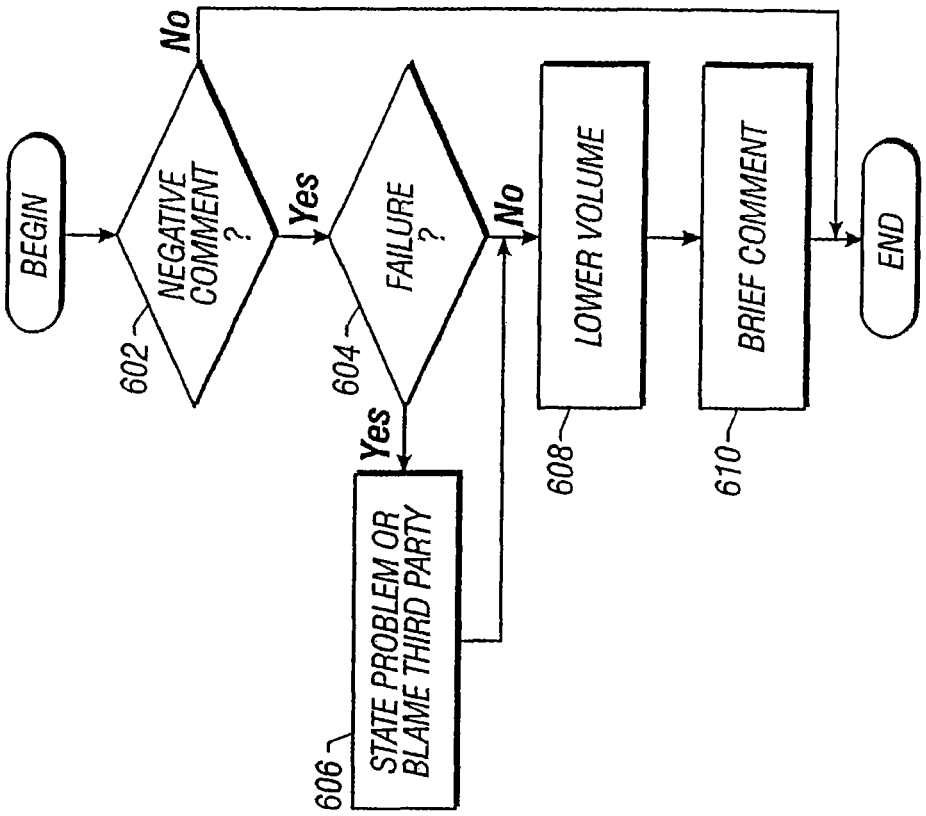

BEGIN
NEGATIVE COMMENT ?
602
No
Yes
FAILURE ?
604
No
Yes
STATE PROBLEM OR BLAME THIRD PARTY
606
LOWER VOLUME
608
BRIEF COMMENT
610
END

FIG. 6

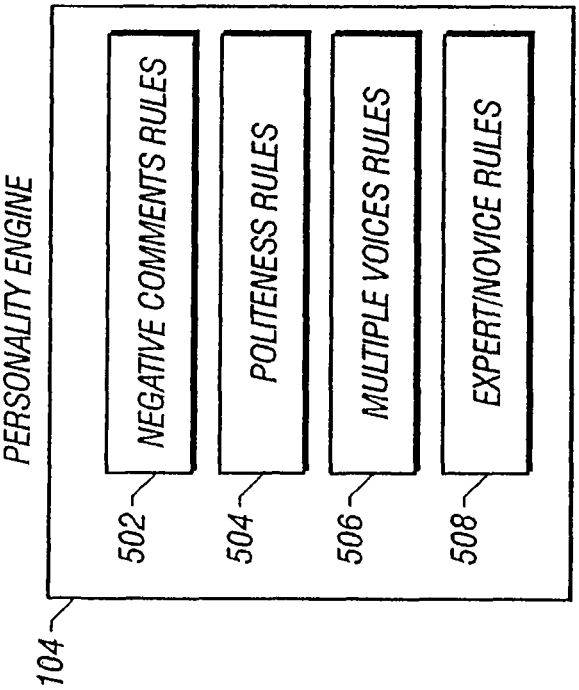

PERSONALITY ENGINE
NEGATIVE COMMENTS RULES
POLITENESS RULES
MULTIPLE VOICES RULES
EXPERT/NOVICE RULES
502
504
506
508
104

FIG. 5

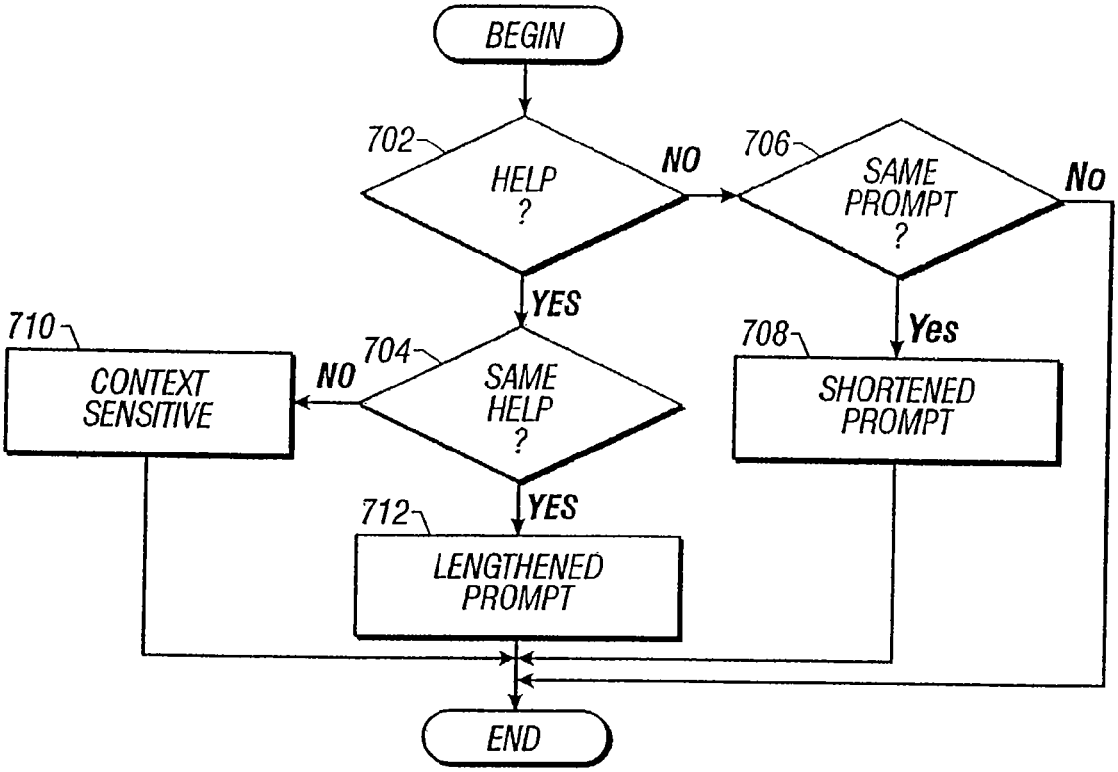

BEGIN
702
HELP ?
NO
706
SAME PROMPT ?
No
YES
Yes
710
CONTEXT SENSITIVE
NO
704
SAME HELP ?
708
SHORTENED PROMPT
YES
712
LENGTHENED PROMPT
END

FIG. 7

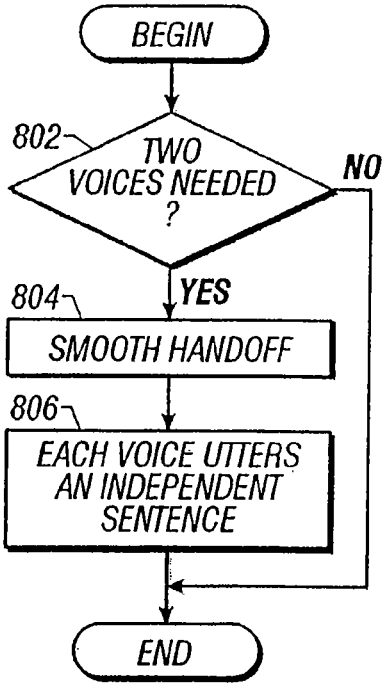
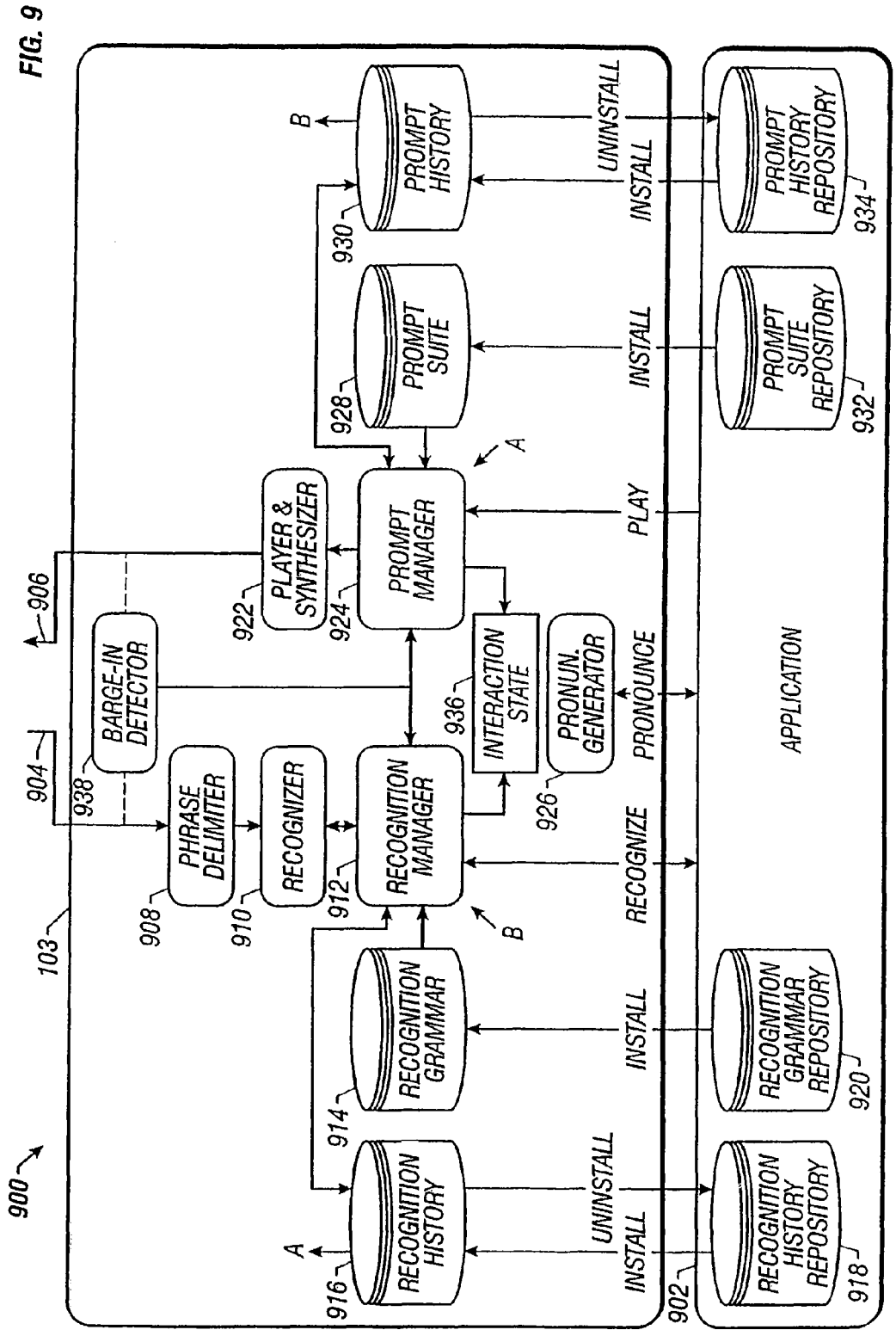

BEGIN
802
TWO VOICES NEEDED ?
NO
YES
804
SMOOTH HANDOFF
806
EACH VOICE UTTERS AN INDEPENDENT SENTENCE
END

FIG. 8

FIG. 9


900
902
103
904
906
908
910
912
914
916
918
920
922
924
926
928
930
932
934
936
938
APPLICATION
BARGE-IN DETECTOR
PHRASE DELIMITER
RECOGNIZER
RECOGNITION MANAGER
RECOGNITION GRAMMAR
RECOGNITION HISTORY
PLAYER & SYNTHESIZER
PROMPT MANAGER
PROMPT SUITE
PROMPT HISTORY
PRONUN. GENERATOR
INTERACTION STATE
RECOGNITION GRAMMAR REPOSITORY
RECOGNITION HISTORY REPOSITORY
PROMPT SUITE REPOSITORY
PROMPT HISTORY REPOSITORY
INSTALL
UNINSTALL
RECOGNIZE
PRONOUNCE
PLAY
A
B

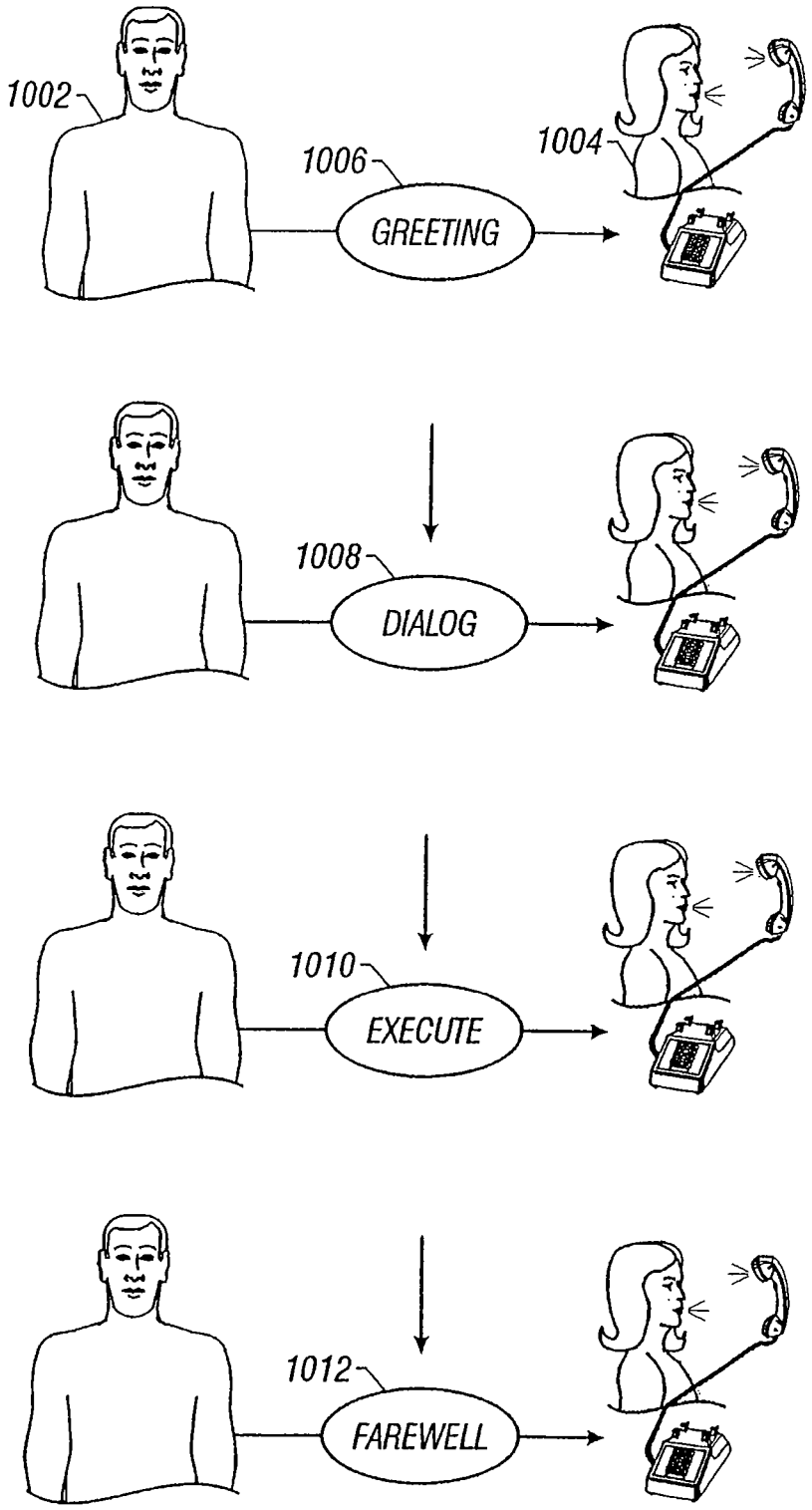

1002
1004
1006
GREETING
1008
DIALOG
1010
EXECUTE
1012
FAREWELL

FIG. 10

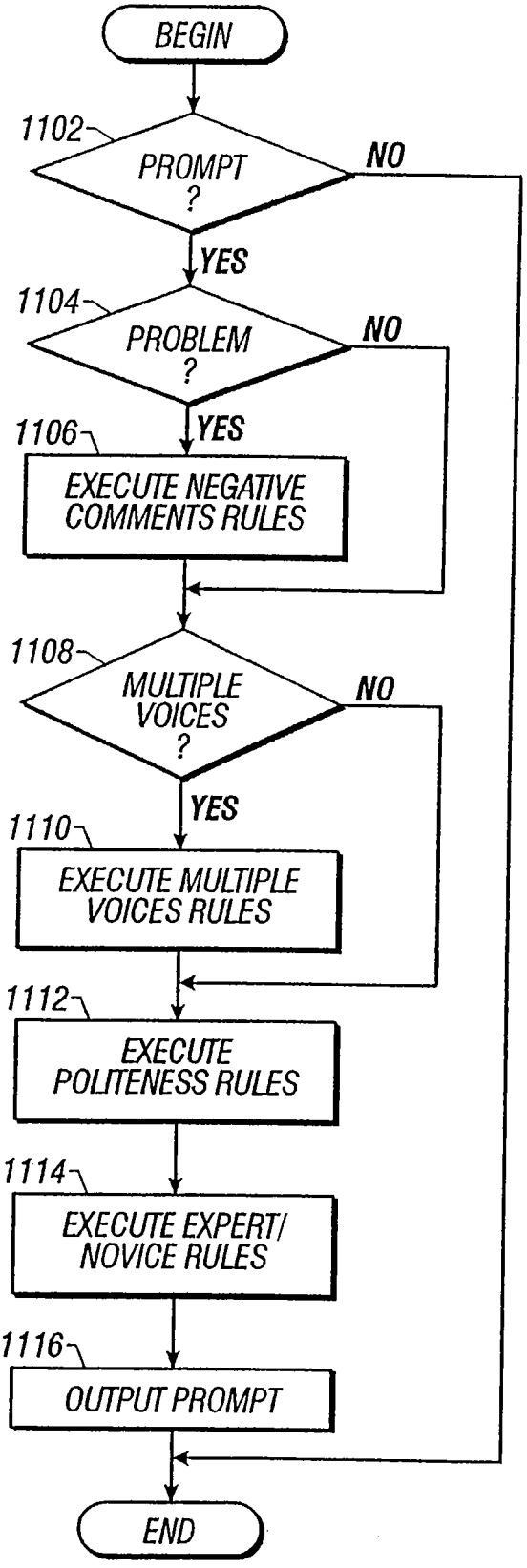

BEGIN
1102
PROMPT ?
NO
YES
1104
PROBLEM ?
NO
YES
1106
EXECUTE NEGATIVE COMMENTS RULES
1108
MULTIPLE VOICES ?
NO
YES
1110
EXECUTE MULTIPLE VOICES RULES
1112
EXECUTE POLITENESS RULES
1114
EXECUTE EXPERT/ NOVICE RULES
1116
OUTPUT PROMPT
END

FIG. 11

Example: `Modify an appointment on June 13 at 3 p.m. (modify, appointment).

MODIFY APPOINTMENT Belongs to family of commands which we reference as :	*<COMMAND><OBJECT><OPTION1><OPTION2> <COMMAND>=modify,<OBJECT>= appointment, <OPTION1>=date<OPTION2>=time*

Processing starts at the upper right and proceeds left to right and top to bottom

FIG. 12

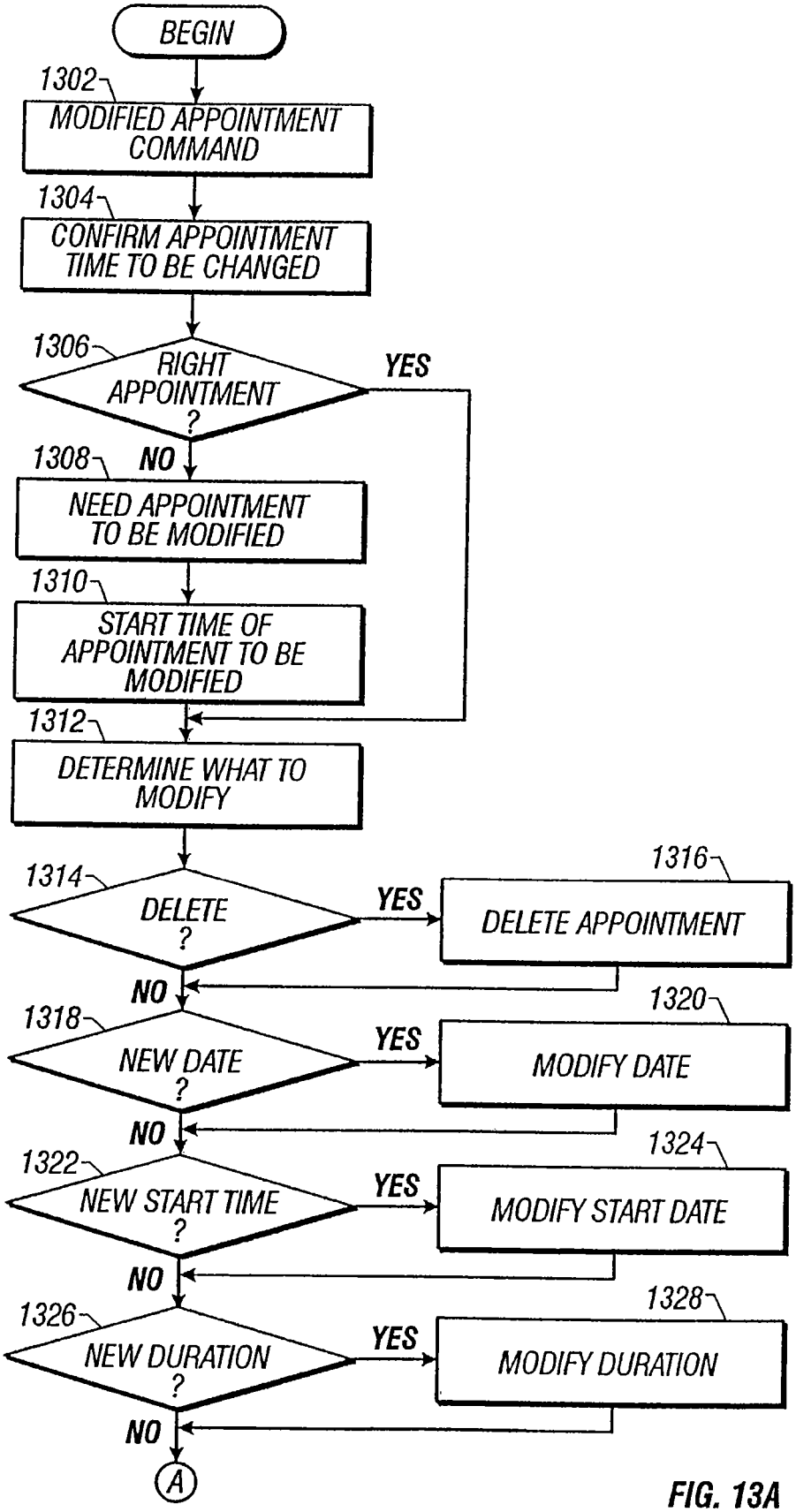

BEGIN
1302
MODIFIED APPOINTMENT COMMAND
1304
CONFIRM APPOINTMENT TIME TO BE CHANGED
1306
RIGHT APPOINTMENT ?
YES
NO
1308
NEED APPOINTMENT TO BE MODIFIED
1310
START TIME OF APPOINTMENT TO BE MODIFIED
1312
DETERMINE WHAT TO MODIFY
1314
DELETE ?
YES
1316
DELETE APPOINTMENT
NO
1318
NEW DATE ?
YES
1320
MODIFY DATE
NO
1322
NEW START TIME ?
YES
1324
MODIFY START DATE
NO
1326
NEW DURATION ?
YES
1328
MODIFY DURATION
NO
A

FIG. 13A

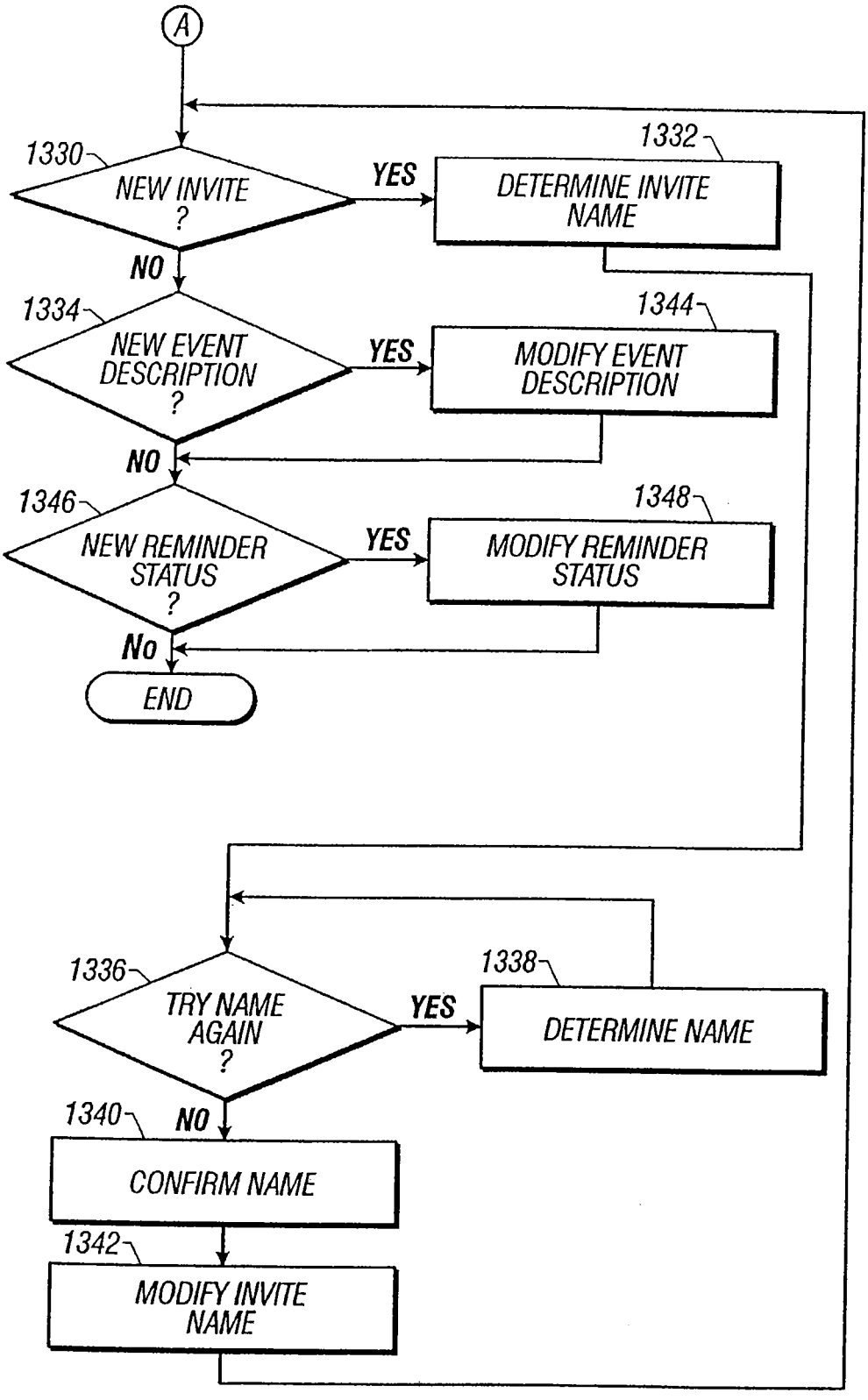

A
1330
NEW INVITE ?
YES
1332
DETERMINE INVITE NAME
NO
1334
NEW EVENT DESCRIPTION ?
YES
1344
MODIFY EVENT DESCRIPTION
NO
1346
NEW REMINDER STATUS ?
YES
1348
MODIFY REMINDER STATUS
No
END
1336
TRY NAME AGAIN ?
YES
1338
DETERMINE NAME
1340
NO
CONFIRM NAME
1342
MODIFY INVITE NAME

FIG. 13B

FIG. 14

A
B

LABEL	User says	Flow Control	Computer says
		If<OPTION1>is filled or <OPTION2>is filled, goto T_NEEDAPPOINTMENT	
		Get LAST APPOINTMENT CHANGED	TTS: The last appointment was <say appointment>. Is that the appointment you want to change?
S_RIGHT APPOINTMENTa	\`yes´	set<OPTION1>to date and <OPTION2>to time, goto T_WHATTOMODIFY	
a	or\`no´	say A:; null out <OPTION1>and <OPTION2>: goto T_NEEDAPPOINTMENT	

FIG. 14A

a	or`help´	goto T_HELP	
a	or TIMEOUT	say A:; goto S_RIGHTAPPOINTMENT	A: Hurry up and say something.
a	or BAD_SCORE	If failure_count <4, say A and goto S_RIGHTAPPOINTMENT or else say B and goto MainDialog	A: I couldn't understand that. B: I give up. Going back to main menu.
T_NEEDAPPOINTMENT		If<OPTION1>is filled, goto T_STARTTIME	PROMPT FOR INPUT, e.g. What's the date of the appointment you'd like to modify?" "Okay. Tell me the date and I can pull that information up for you" "Okay. Give me the date and we'll take a look." "Okay. Give me the date and I'll check your calendar."
S_DATE b	[date]	Goto S_STARTTIME	
b	or`help´	goto HELP	

FIG. 14B

Mail Domain	
mail_top_navlist	What do you want me to do with your mail? Ready. What can I do for you? Okay, mail's ready. How can I help you? I'm looking at you messages on my monitor. What would you like me to do? Okay, ready. Tell me what you'd like me to do. What can I do for you?
mail_sum_all_voicemail_none	You have no voicemail. You don't have anything right now. I don't have any voicemail for you right now. There aren't any voicemail messages. There aren't any messages for you at the moment. I'm afraid there isn't any voicemail. I'm afraid there's no voicemail at all, old or new. You've checked so recently, there are no voicemail messages waiting. Sorry, the computer tells me there aren't any voicemail messages for us. Bad computer, no biscuit. And no voicemail messages either. The voicemail message queue is empty right now.
gu_mail_reply_recipient	I'm having trouble, too. Let's leave this alone for now. You know what? There's a problem that has me stumped for the moment. I'm afraid we have to go back to the top. This has gone from embarrassing to mortifying. I'm really sorry. Could we please start over again? We appear to be stuck right now. Hope you don't mind if we take it from the top. <Chuckle> This isn't going well, is it? Let's start over.

FIG. 15

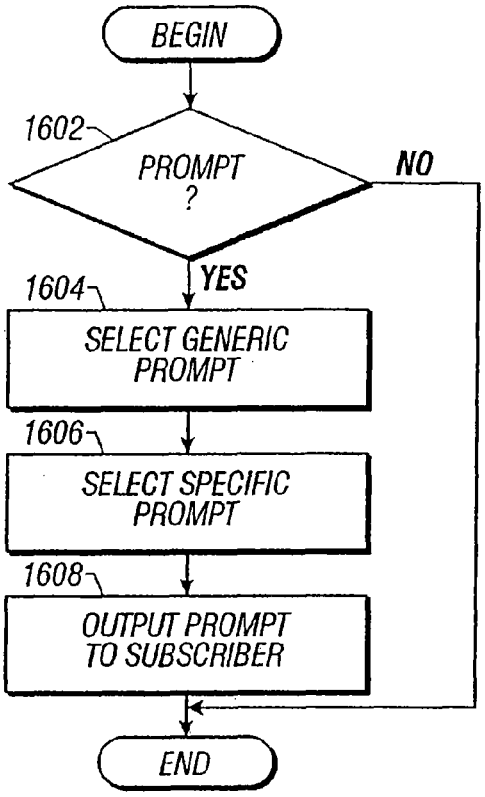

BEGIN
1602
PROMPT ?
NO
YES
1604
SELECT GENERIC PROMPT
1606
SELECT SPECIFIC PROMPT
1608
OUTPUT PROMPT TO SUBSCRIBER
END

FIG. 16

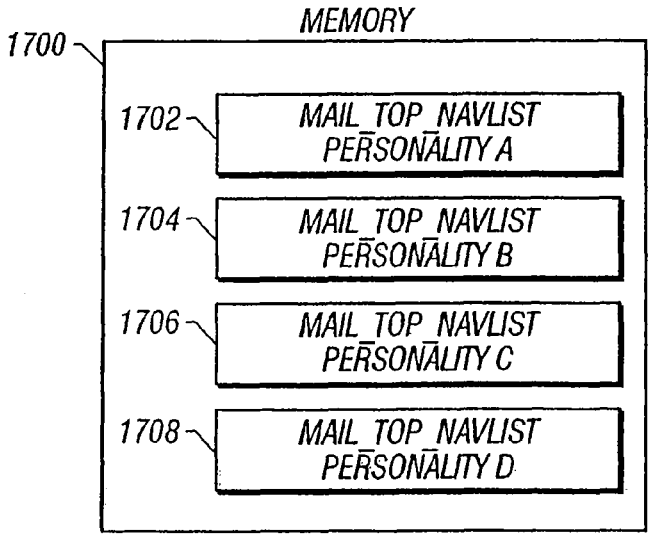

MEMORY
1700
1702
MAIL_TOP_NAVLIST PERSONALITY A
1704
MAIL_TOP_NAVLIST PERSONALITY B
1706
MAIL_TOP_NAVLIST PERSONALITY C
1708
MAIL_TOP_NAVLIST PERSONALITY D

FIG. 17

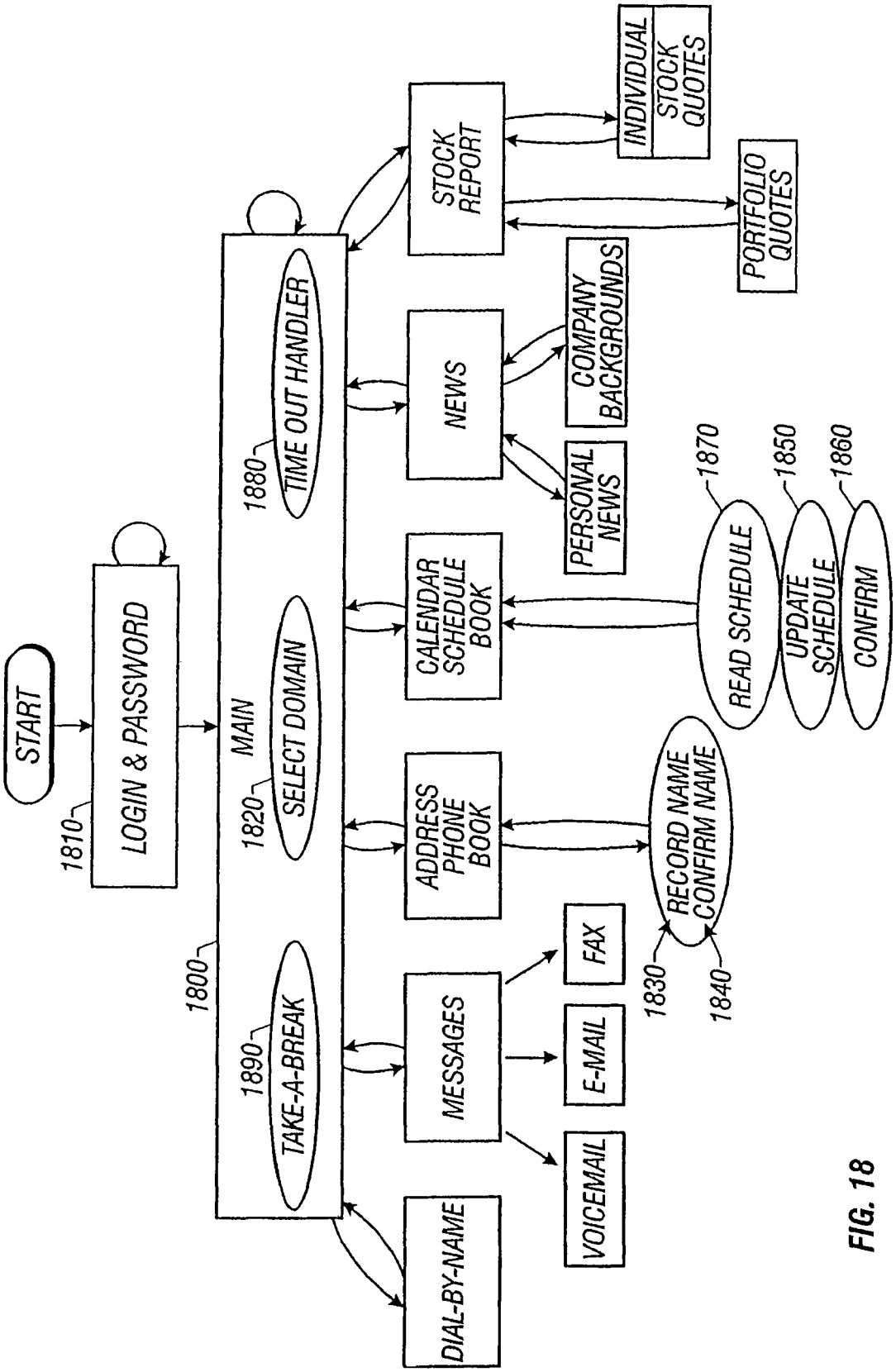

START
LOGIN & PASSWORD
1810
MAIN
1800
SELECT DOMAIN
1820
TIME OUT HANDLER
1880
TAKE-A-BREAK
1890
STOCK REPORT
NEWS
CALENDAR SCHEDULE BOOK
ADDRESS PHONE BOOK
MESSAGES
DIAL-BY-NAME
INDIVIDUAL STOCK QUOTES
PORTFOLIO QUOTES
COMPANY BACKGROUNDS
PERSONAL NEWS
READ SCHEDULE
1870
UPDATE SCHEDULE
1850
CONFIRM
1860
RECORD NAME CONFIRM NAME
1830
1840
FAX
E-MAIL
VOICEMAIL

FIG. 18

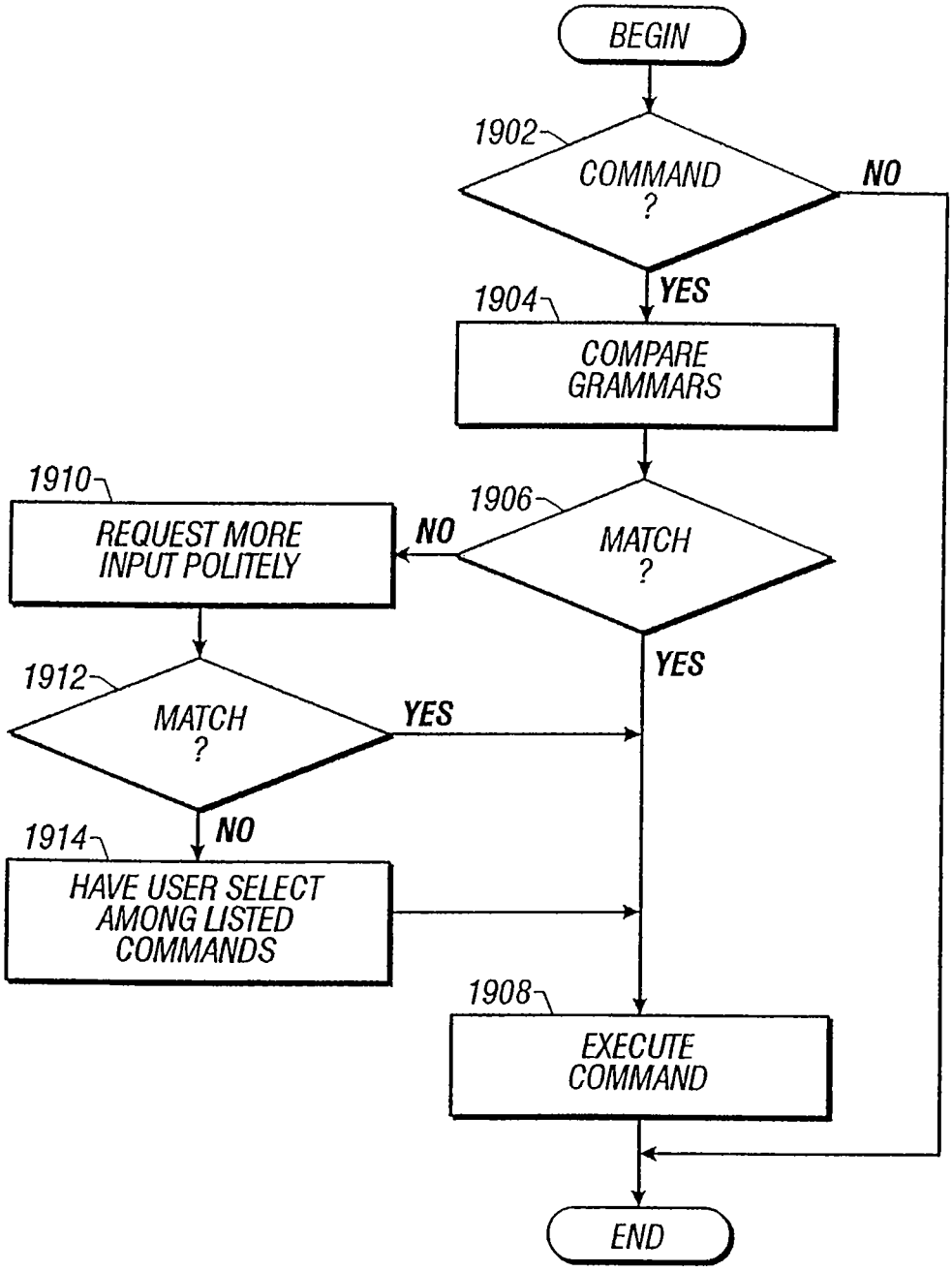

BEGIN
1902
COMMAND ?
NO
YES
1904
COMPARE GRAMMARS
1906
MATCH ?
NO
1910
REQUEST MORE INPUT POLITELY
YES
1912
MATCH ?
YES
NO
1914
HAVE USER SELECT AMONG LISTED COMMANDS
1908
EXECUTE COMMAND
END

FIG. 19

VOICE USER INTERFACE WITH PERSONALITY

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. application Ser. No. 11/314,002, filed on Dec. 22, 2005, entitled "VOICE USER INTERFACE WITH PERSONALITY," by SURACE et al., which is a continuation of U.S. application Ser. No. 09/924,420, filed Aug. 7, 2001, entitled "VOICE USER INTERFACE WITH PERSONALITY," by SURACE et al., now U.S. Pat. No. 7,058,577, which is a continuation of U.S. application Ser. No. 09/654,174, filed Sep. 1, 2000, entitled "VOICE USER INTERFACE WITH PERSONALITY," by SURACE et al., now U.S. Patent No. 6,334,103, which is a continuation of U.S. application Ser. No. 09/071,717, filed May 1, 1998, entitled "VOICE USER INTERFACE WITH PERSONALITY," by SURACE et al., now U.S. Pat. No. 6,144,938, all of which are herein incorporated by reference in their entireties.

CROSS-REFERENCE TO MICROFICHE APPENDICES

U.S. application Ser. No. 09/924,420, filed Aug. 7, 2001, entitled "VOICE USER INTERFACE WITH PERSONALITY," by SURACE et al., includes nineteen sheets of microfiche with 1,270 frames representing Appendices C-H, which are herein incorporated by reference in their entireties.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to user interfaces and, more particularly, to a voice user interface with personality.

2. Background

Personal computers (PCs), sometimes referred to as microcomputers, have gained widespread use in recent years, primarily, because they are inexpensive and yet powerful enough to handle computationally-intensive applications. PCs typically include graphical user interfaces (GUIs). Users interact with and control an application executing on a PC using a GUI. For example, the Microsoft WINDOWS™ Operating System (OS) represents an operating system that provides a GUI. A user controls an application executing on a PC running the Microsoft WINDOWS™ OS using a mouse to select menu commands and click on and move icons.

The increasingly powerful applications for computers have led to a growing use of computers for various computer telephony applications. For example, voice mail systems are typically implemented using software executing on a computer that is connected to a telephone line for storing voice data signals transmitted over the telephone line. A user of a voice mail system typically controls the voice mail system using dual tone multiple frequency (DTMF) commands and, in particular, using a telephone keypad to select the DTMF commands available. For example, a user of a voice mail system typically dials a designated voice mail telephone number, and the user then uses keys of the user's telephone keypad to select various commands of the voice mail system's command hierarchy. Telephony applications can also include a voice user interface that recognizes speech signals and outputs speech signals.

SUMMARY

The present invention provides a voice user interface with personality. For example, the present invention provides a cost-effective and high performance computer-implemented voice user interface with personality that can be used for various applications in which a voice user interface is desired such as telephony applications.

In one embodiment, a method includes executing a voice user interface, and controlling the voice user interface to provide the voice user interface with a personality. A prompt is selected among various prompts based on various criteria. For example, the prompt selection is based on a prompt history. Accordingly, this embodiment provides a computer system that executes a voice user interface with personality.

In one embodiment, controlling the voice user interface includes selecting a smooth hand-off prompt to provide a smooth hand-off between a first voice and a second voice of the voice user interface, selecting polite prompts such that the voice user interface behaves consistently with social and emotional norms, including politeness, while interacting with a user of the computer system, selecting brief negative prompts in situations in which negative comments are required, and selecting a lengthened prompt or shortened prompt based on a user's experience with the voice user interface.

In one embodiment, controlling the voice user interface includes providing the voice user interface with multiple personalities. The voice user interface with personality installs a prompt suite for a particular personality from a prompt repository that stores multiple prompt suites, in which the multiple prompt suites are for different personalities of the voice user interface with personality.

Other aspects and advantages of the present invention will become apparent from the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a voice user interface with personality in accordance with one embodiment of the present invention.

FIG. **2** is a block diagram of a voice user interface with personality that includes multiple personalities in accordance with one embodiment of the present invention.

FIG. **3** is a flow diagram illustrating a process for implementing a computer-implemented voice user interface with personality in accordance with one embodiment of the present invention.

FIG. **4** is a block diagram of the computer-implemented voice user interface with personality of FIG. **1** shown in greater detail in accordance with one embodiment of the present invention.

FIG. **5** is a block diagram of the personality engine of FIG. **1** shown in greater detail in accordance with one embodiment of the present invention.

FIG. **6** is a flow diagram of the operation of the negative comments rules of the personality engine of FIG. **5** in accordance with one embodiment of the present invention.

FIG. **7** is a flow diagram of the operation of the politeness rules of the personality engine of FIG. **5** in accordance with one embodiment of the present invention.

FIG. **8** is a flow diagram of the operation of the multiple voices rules of the personality engine of FIG. **5** in accordance with one embodiment of the present invention.

FIG. **9** is a block diagram of a voice user interface with personality for an application in accordance with one embodiment of the present invention.

FIG. **10** is a functional diagram of a dialog interaction between the voice user interface with personality and a subscriber in accordance with one embodiment of the present invention.

FIG. **11** is a flow diagram of the operation of the voice user interface with personality of FIG. **10** during an interaction with a subscriber in accordance with one embodiment of the present invention.

FIG. **12** provides a command specification of a modify appointment command for the system of FIG. **9** in accordance with one embodiment of the present invention.

FIGS. **13**A and **13**B are a flow diagram of a dialog for a modify appointment command between the voice user interface with personality of FIG. **10** and a subscriber in accordance with one embodiment of the present invention.

FIG. **14** shows a subset of the dialog for the modify appointment command of the voice user interface with personality of FIG. **10** in accordance with one embodiment of the present invention.

FIG. **15** provides scripts written for a mail domain of the system of FIG. **9** in accordance with one embodiment of the present invention.

FIG. **16** is a flow diagram for selecting and executing a prompt by the voice user interface with personality of FIG. **10** in accordance with one embodiment of the present invention.

FIG. **17** is a block diagram of a memory that stores recorded prompts in accordance with one embodiment of the present invention.

FIG. **18** is a finite state machine diagram of the voice user interface with personality of FIG. **10** in accordance with one embodiment of the present invention.

FIG. **19** is a flow diagram of the operation of the voice user interface with personality of FIG. **10** using a recognition grammar in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a voice user interface with personality. The term "personality" as used in the context of a voice user interface can be defined as the totality of spoken language characteristics that simulate the collective character, behavioral, temperamental, emotional, and mental traits of human beings in a way that would be recognized by psychologists and social scientists as consistent and relevant to a particular personality type. For example, personality types include the following: friendly-dominant, friendly-submissive, unfriendly-dominant, and unfriendly-submissive. Accordingly, a computer system that interacts with a user (e.g., over a telephone) and in which it is desirable to offer a voice user interface with personality would particularly benefit from the present invention.

A Voice User Interface with Personality

FIG. **1** is a block diagram of a voice user interface with personality in accordance with one embodiment of the present invention. FIG. **1** includes a computer system **100**. Computer system **100** includes a memory **101** (e.g., volatile and non-volatile memory) and a processor **105** (e.g., an Intel PENTIUM™ microprocessor), and computer system **100** is connected to a standard display **116** and a standard keyboard **118**. These elements are those typically found in most general purpose computers, and in fact, computer system **100** is intended to be representative of a broad category of data processing devices. Computer system **100** can also be in communication with a network (e.g., connected to a LAN). It will be appreciated by one of ordinary skill in the art that computer system **100** can be part of a larger system.

Memory **101** stores a voice user interface with personality **103** that interfaces with an application **106**. Voice user interface with personality **103** includes voice user interface software **102** and a personality engine **104**. Voice user interface software **102** is executed on processor **105** to allow user **112** to verbally interact with application **106** executing on computer system **100** via a microphone and speaker **114**. Computer system **100** can also be controlled using a standard graphical user interface (GUI) (e.g., a Web browser) via keyboard **118** and monitor **116**.

Voice user interface with personality **103** uses a dialog to interact with user **112**. Voice user interface with personality **103** interacts with user **112** in a manner that gives user **112** the impression that voice user interface with personality **103** has a personality. The personality of voice user interface with personality **103** is generated using personality engine **104**, which controls the dialog output by voice user interface ("VUI") software **102** during interactions with user **112**. For example, personality engine ("PE") **104** can implement any application-specific, cultural, politeness, psychological, or social rules and norms that emulate or model human verbal behavior (e.g., providing varied verbal responses) such that user **112** receives an impression of a voice user interface with a personality when interacting with computer system **100**. Accordingly, voice user interface with personality **103** executed on computer system **100** provides a computer-implemented voice user interface with personality.

FIG. **2** is a block diagram of a voice user interface with personality that includes multiple personalities in accordance with one embodiment of the present invention. FIG. **2** includes a computer system **200**, which includes a memory **201** (e.g., volatile and non-volatile memory) and a processor **211** (e.g., an Intel PENTIUM™ microprocessor). Computer system **200** can be a standard computer or any data processing device. It will be appreciated by one of ordinary skill in the art that computer system **200** can be part of a larger system.

Memory **201** stores a voice user interface with personality **203**, which interfaces with an application **211** (e.g., a telephony application that provides a voice mail service). Voice user interface with personality **203** includes voice user interface ("VUI") software **202**. Voice user interface with personality **203** also includes a personality engine ("PE") **204**. Personality engine **204** controls voice user interface software **202** to provide a voice user interface with a personality. For example, personality engine **204** provides a friendly-dominant personality that interacts with a user using a dialog of friendly directive statements (e.g., statements that are spoken typically as commands with few or no pauses).

Memory **201** also stores a voice user interface with personality **205**, which interfaces with application **211**. Voice user interface with personality **205** includes voice user interface ("VUI") software **208**. Voice user interface with personality **205** also includes a personality engine ("PE") **206**. Personality engine **206** controls voice user interface software **208** to provide a voice user interface with a personality. For example, personality engine **206** provides a friendly-submissive personality that interacts with a user using a dialog of friendly but submissive statements (e.g., statements that are spoken typically as questions and with additional explanation or pause).

User **212** interacts with voice user interface with personality **203** executing on computer system **200** using a telephone

214 that is in communication with computer system 200 via a network 215 (e.g., a telephone line). User 218 interacts with voice user interface with personality 205 executing on computer system 200 using a telephone 216 that is in communication with computer system 200 via network 215.

An Overview of an Implementation of a Computer-Implemented Voice User Interface with Personality

FIG. 3 is a flow diagram illustrating a process for implementing a computer-implemented voice user-interface with personality in accordance with one embodiment of the present invention.

At stage 300, market requirements are determined. The market requirements represent the desired application functionality of target customers or subscribers for a product or service, which includes a voice user interface with personality.

At stage 302, application requirements are defined. Application requirements include functional requirements of a computer-implemented system that will interact with users using a voice user interface with personality. For example, application requirements include various functionality such as voice mail and electronic mail (email). The precise use of the voice user interface with personality within the system is also determined.

At stage 304, a personality is selected. The personality can be implemented as personality engine 104 to provide a voice user interface 102 with personality. For example, a voice user interface with personality uses varied responses to interact with a user.

In particular, those skilled in the art of, for example, social psychology review the application requirements, and they then determine which personality types best serve the delivery of a voice user interface for the functions or services included in the application requirements. A personality or multiple personalities are selected, and a complete description is created of a stereotypical person displaying the selected personality or personalities, such as age, gender, education, employment history, and current employment position. Scenarios are developed for verbal interaction between the stereotypical person and typical users.

At stage 306, an actor is selected to provide the voice of the selected personality. The selection of an actor for a particular personality is further discussed below.

At stage 308, a dialog is generated based on the personality selected at stage 304. The dialog represents the dialog that the voice user interface with personality uses to interact with a user at various levels within a hierarchy of commands of the system. For example, the dialog can include various greetings that are output to a user when the user logs onto the system. In particular, based on the selected personality, the dialogs are generated that determine what the computer-implemented voice user interface with personality can output (e.g., say) to a user to start various interactions, and what the computer-implemented voice user interface with personality can output to respond to various types of questions or responses in various situations during interactions with the user.

At stage 310, scripts are written for the dialog based on the selected personality. For example, scripts for a voice user interface with personality that uses varied responses can be written to include varied greetings, which can be randomly selected when a user logs onto the system to be output by the voice user interface with personality to the user. During stage 310, script writers, such as professional script writers who would typically be writing for television programs or movies, are given the dialogs generated during stage 308 and instructed to re-write the dialogs using language that consistently represents the selected personality.

At stage 312, the application is implemented. The application is implemented based on the application requirements and the dialog. For example, a finite state machine can be generated, which can then be used as a basis for a computer programmer to efficiently and cost-effectively code the voice user interface with personality. In particular, a finite state machine is generated such that all functions specified in the application requirements of the system can be accessed by a user interacting with the computer-implemented voice user interface with personality. The finite state machine is then coded in a computer language that can be compiled or interpreted and then executed on a computer such as computer system 100. For example, the finite state machine can be coded in "C" code and compiled using various C compilers for various computer platforms (e.g., the Microsoft WINDOWS™ OS executing on an Intel X86™/PENTIUM™ microprocessor). The computer programs are executed by a data processing device such as computer system 100 and thereby provide an executable voice user interface with personality. For example, commercially available tools provided by ASR vendors such as Nuance Corporation of Menlo Park, Calif., can be used to guide software development at stage 318.

Stage 314 determines whether the scripted dialog can be practically and efficiently implemented for the voice user interface with personality of the application. For example, if the scripted dialog cannot be practically and efficiently implemented for the voice user interface with personality of the application (e.g., by failing to collect from a user of the application a parameter that is required by the application), then the dialog is refined at stage 308.

At stage 316, the scripts (e.g., prompts) are recorded using the selected actor. The scripts are read by the actor as directed by a director in a manner that provides recorded scripts of the actor's voice reflecting personality consistent with the selected personality. For example, a system that includes a voice user interface with personality, which provides a voice user interface with a friendly-dominant personality would have the speaker speak more softly and exhibit greater pitch range than if the voice user interface had a friendly-submissive personality.

At stage 318, a recognition grammar is generated. The recognition grammar specifies a set of commands that a voice user interface with personality can understand when spoken by a user. For example, a computer-implemented system that provides voice mail functionality can include a recognition grammar that allows a user to access voice mail by saying "get my voice mail", "do I have any voice mail", and "please get me my voice mail". Also, if the voice user interface with personality includes multiple personalities, then each of the personalities of the voice user interface with personality may include a unique recognition grammar.

In particular, commercially available speech recognition systems with recognition grammars are provided by ASR (Automatic Speech Recognition) technology vendors such as the following: Nuance Corporation of Menlo Park, Calif.; Dragon Systems of Newton, Mass.; IBM of Austin, Tex.; Kurzweil Applied Intelligence of Waltham, Mass.; Lernout Hauspie Speech Products of Burlington, Mass.; and PureSpeech, Inc. of Cambridge, Mass. Recognition grammars are written specifying what sentences and phrases are to be recognized by the voice user interface with personality (e.g., in different states of the finite state machine). For example, a recognition grammar can be generated by a computer scientist or a computational linguist or a linguist. The accuracy of the speech recognized ultimately depends on the selected recognition grammars. For example, recognition grammars

that permit too many alternatives can result in slow and inaccurate ASR performance. On the other hand, recognition grammars that are too restrictive can result in a failure to encompass a users' input. In other words, users would either need to memorize what they could say or be faced with a likely failure of the ASR system to recognize what they say as the recognition grammar did not anticipate the sequence of words actually spoken by the user. Thus, crafting of recognition grammars can often be helped by changing the prompts of the dialog. A period of feedback is generally helpful in tabulating speech recognition errors such that recognition grammars can be modified and scripts modified as well as help generated in order to coach a user to say phrases or commands that are within the recognition grammar.

A Computer-Implemented Voice User Interface with Personality

FIG. **4** is a block diagram of the computer-implemented voice user interface with personality of FIG. **1** shown in greater detail in accordance with one embodiment of the present invention. FIG. **4** includes computer system **100** that executes voice user interface software **102** that is controlled by personality engine **104**. Voice user interface software **102** interfaces with an application **410** (e.g., a telephony application). Computer system **100** can be a general purpose computer such as a personal computer (PC). For example, computer system **100** can be a PC that includes an Intel PENTIUM™ running the Microsoft WINDOWS 95™ operating system (OS) or the Microsoft WINDOWS NT™ OS.

Computer system **100** includes telephone line cards **402** that allow computer system **100** to communicate with telephone lines **413**. Telephone lines **413** can be analog telephone lines, digital T1 lines, digital T3 lines, or OC3 telephony feeds. For example, telephone line cards **402** can be commercially available telephone line cards with 24 lines from Dialogic Corporation of Parsippany, N.J., or commercially available telephone line cards with 2 to 48 lines from Natural MicroSystems Inc. of Natick, Mass. Computer system **100** also includes a LAN (Local Area Network) connector **403** that allows computer system **100** to communicate with a network such as a LAN or Internet **404**, which uses the well-known TCP/EP (Transmission Control Protocol/Internet Protocol). For example, LAN card **403** can be a commercially available LAN card from 3COM Corporation of Santa Clara, Calif. The voice user interface with personality may need to access various remote databases and, thus, can reach the remote databases via LAN or Internet **404**. Accordingly, the network, LAN or Internet **404**, is integrated into the system, and databases residing on remote servers can be accessed by voice user interface software **102** and personality engine **104**.

Users interact with voice user interface software **102** over telephone lines **413** through telephone line cards **402** via speech input data **405** and speech output data **412**. For example, speech input data **405** can be coded as 32-kilobit ADPCM (Adaptive Differential Pulse Coded Modulation) or 64-KB MU-law parameters using commercially available modulation devices from Rockwell International of Newport Beach, Calif.

Voice user interface software **102** includes echo cancellation software **406**. Echo cancellation software **406** removes echoes caused by delays in the telephone system or reflections from acoustic waves in the immediate environment of the telephone user such as in an automobile. Echo cancellation software **406** is commercially available from Noise Cancellation Technologies of Stamford, Conn.

Voice user interface software **102** also includes barge-in software **407**. Barge-in software detects speech from a user in contrast to ambient background noise. When speech is detected, any speech output from computer system **100** such as via speech output data **412** is shut off at its source in the software so that the software can attend to the new speech input. The effect observed by a user (e.g., a telephone caller) is the ability of the user to interrupt computer system **100** generated speech simply by talking. Barge-in software **407** is commercially available from line card manufacturers and ASR technology suppliers such as Dialogic Corporation of Parsippany, N.J., and Natural MicroSystems Inc. of Natick, Mass. Barge-in increases an individual's sense that they are interacting with a voice user interface with personality.

Voice user interface software **102** also includes signal processing software **408**. Speech recognizers typically do not operate directly on time domain data such as ADPCM. Accordingly, signal processing software **408** performs signal processing operations, which result in transforming speech into a series of frequency domain parameters such as standard cepstral coefficients. For example, every 10 milliseconds, a twelve-dimensional vector of cepstral coefficients is produced to model speech input data **405**. Signal processing software **408** is commercially available from line card manufacturers and ASR technology suppliers such as Dialogic Corporation of Parsippany, N.J., and Natural MicroSystems Inc. of Natick, Mass.

Voice user interface software **102** also includes ASR/NL software **409**. ASR/NL software **409** performs automatic speech recognition (ASR) and natural language (NL) speech processing. For example, ASR/NL software is commercially available from the following companies: Nuance Corporation of Menlo Park, Calif., as a turn-key solution; Applied Language Technologies, Inc. of Boston, Mass.; Dragon Systems of Newton, Mass.; and PureSpeech, Inc. of Cambridge, Mass. The natural language processing component can be obtained separately as commercially available software products from UNISYS Corporation of Blue Bell, Pa. The commercially available software typically is modified for particular applications such as a computer telephony application. For example, the voice user interface with personality can be modified to include a customized grammar, as further discussed below.

Voice user interface software **102** also includes TTS/recorded speech output software **411**. Text-to-speech (TTS)/recorded speech output software **411** provides functionality that enables computer system **100** to talk (e.g., output speech via speech output data **412**) to a user of computer system **100**. For example, if the information to be communicated to the user or the caller originates as text such as an email document, then TTS software **411** speaks the text to the user via speech output data **412** over telephone lines **413**. For example, TTS software is commercially available from the following companies: AcuVoice, Inc. of San Jose, Calif.; Centigram Communications Corporation of San Jose, Calif.; Digital Equipment Corporation (DEC) of Maynard, Mass.; Lucent Technologies of Murray Hill, N.J.; and Entropic Research Laboratory, Inc. of Menlo Park, Calif. TTS/recorded speech software **411** also allows computer system **100** to output recorded speech (e.g., recorded prompts) to the user via speech output data **412** over telephone lines **413**. For example, several thousand recorded prompts can be stored in memory **101** of computer system **100** (e.g., as part of personality engine **104**) and played back at any appropriate time, as further discussed below. Accordingly, the variety and personality provided by the recorded prompts and the context sensitivity of the selection and output of the recorded prompts by personality engine **104** provides a voice user interface with personality implemented in computer system **100**.

Application **410** is in communication with a LAN or the Internet **404**. For example, application **410** is a telephony application that provides access to email, voice mail, fax, calendar, address book, phone book, stock quotes, news, and telephone switching equipment. Application **410** transmits a request for services that can be served by remote computers using the well-known TCP/IP protocol over LAN or the Internet **404**.

Accordingly, voice user interface software **102** and personality engine **104** execute on computer system **100** (e.g., execute on a microprocessor such as an Intel PENTIUM™ microprocessor) to provide a voice user interface with personality that interacts with a user via telephone lines **413**.

Personality Engine

FIG. **5** is a block diagram of the personality engine of FIG. **1** shown in greater detail in accordance with one embodiment of the present invention. Personality engine **104** is a rules-based engine for controlling voice user interface software **102**.

Personality engine **104** implements negative comments rules **502**, which are further discussed below with respect to FIG. **6**. Personality engine **104** also implements politeness rules **504**, which are further discussed below with respect to FIG. **7**. Personality engine **104** implements multiple voices rules **506**, which are further discussed below with respect to FIG. **8**. Personality engine **104** also implements expert/novice rules **508**, which include rules for controlling the voice user interface in situations in which the user learns over time what the system can do and thus needs less helpful prompting. For example, expert/novice rules **508** control the voice user interface such that the voice user interface outputs recorded prompts of an appropriate length (e.g., detail) depending on a particular user's expertise based on the user's current session and based on the user's experience across sessions (e.g., personality engine **104** maintains state information for each user of computer system **100**). Accordingly, personality engine **104** executes various rules that direct the behavior of voice user interface software **102** while interacting with users of the system in order to create an impression upon the user that voice user interface with personality **103** has a personality.

FIG. **6** is a flow diagram of the operation of negative comments rules **502** of personality engine **104** of FIG. **5** in accordance with one embodiment of the present invention. Negative comments rules **502** include rules that are based on social-psychology empirical observations that (i) negative material is generally more arousing than positive material, (ii) people do not like others who criticize or blame, and (iii) people who blame themselves are seen and viewed as less competent. Accordingly, FIG. **6** is a flow diagram of the operation of negative comments rules **502** that implements these social-psychology empirical observations in accordance with one embodiment of the present invention.

At stage **602**, it is determined whether a negative comment is currently required (i.e., whether voice user interface software **102** is at a stage of interaction with a user at which voice user interface software **102** needs to provide some type of negative comment to the user). If so, operation proceeds to stage **604**.

At stage **604**, it is determined whether there has been a failure (i.e., whether the negative comment is one that reports a failure). If so, operation proceeds to stage **606**. Otherwise, operation proceeds to stage **608**

At stage **606**, a prompt (e.g., a recorded prompt) that briefly states the problem or blames a third party is selected. This state the problem or blame a third party rule is based on a social-psychology empirical observation that when there is a failure, a system should neither blame the user nor take blame itself, but instead the system should simply state the problem or blame a third party. For example, at stage **606**, a recorded prompt that states the problem or blames a third party is selected, such as "there seems to be a problem in getting your appointments for today" or "the third-party news service is not working right now" to the user.

At stage **608**, the volume is lowered for audio data output to the user, such as speech output data **412**, for the subsequent negative comment (e.g., recorded prompt) to be uttered by recorded speech software **411** of voice user interface software **102**. This lower the volume rule is based on a social-psychology empirical observation that negative comments should generally have a lower volume than positive comments.

At stage **610**, a brief comment (e.g., outputs a brief recorded prompt) is selected to utter as the negative comment to the user. This brief comment rule is based on a social-psychology empirical observation that negative comments should be shorter and less elaborate than positive comments.

FIG. **7** is a flow diagram of the operation of politeness rules **504** of personality engine **104** of FIG. **5** in accordance with one embodiment of the present invention. Politeness rules **504** include rules that are based on Grice's maxims for politeness as follows: the quantity that a person should say during a dialog with another person should be neither more nor less than is needed, comments should be relevant and apply to the previous conversation, comments should be clear and comprehensible, and comments should be correct in a given context. Accordingly, FIG. **7** is a flow diagram of the operation of politeness rules **504** that implements Grice's maxims for politeness in accordance with one embodiment of the present invention.

At stage **702**, it is determined whether help is required or requested by the user. If so, operation proceeds to stage **704**. Otherwise, operation proceeds to stage **706**.

At stage **704**, it is determined whether the user is requiring repeated help in the same session or across sessions (i.e., a user is requiring help more than once in the current session). If so, operation proceeds to stage **712**. Otherwise, operation proceeds to stage **710**.

At stage **706**, it is determined whether a particular prompt is being repeated in the same session (i.e., the same session with a particular user) or across sessions. If so, operation proceeds to stage **708**. At stage **708**, politeness rules **504** selects a shortened prompt (e.g., selects a shortened recorded prompt) for output by voice user interface software **102**. This shortened prompt rule is based on a social-psychology empirical observation that the length of prompts should become shorter within a session and across sessions, unless the user is having trouble, in which case the prompts should become longer (e.g., more detailed).

At stage **712**, a lengthened help explanation (e.g., recorded prompt) is selected for output by voice user interface software **102**. For example, the lengthened help explanation can be provided to a user based on the user's help requirements in the current session and across sessions (e.g., personality engine **104** maintains state information for each user of computer system **100**). This lengthened help rule is based on a social-psychology empirical observation that help explanations should get longer and more detailed both within a session and across sessions.

At stage **710**, a prompt that provides context-sensitive help is selected for output by voice user interface software **102**. For example, the context-sensitive help includes informing the user of the present state of the user's session and available options (e.g., an explanation of what the user can currently instruct the system to do at the current stage of operation).

This context-sensitive help rule is based on a social-psychology empirical observation that a system should provide the ability to independently request, in a context-sensitive way, any of the following: available options, the present state of the system, and an explanation of what the user can currently instruct the system to do at the current stage of operation.

In one embodiment, a prompt is selected for output by voice user interface software **102**, in which the selected prompt includes terms that are recognized by voice user interface with personality **103** (e.g., within the recognition grammar of the voice user interface with personality). This functionality is based on the social-psychology empirical observation that it is polite social behavior to use words introduced by the other person (in this case the voice user interface with personality) in conversation. Thus, this functionality is advantageous, because it increases the probability that a user will interact with voice user interface with personality **103** using words that are recognized by the voice user interface with personality. Politeness rules **504** can also include a rule that when addressing a user by name, voice user interface with personality **103** addresses the user by the user's proper name, which generally represents a socially polite manner of addressing a person (e.g., a form of flattery).

Another social-psychology empirical observation that can be implemented by politeness rules **504** and executed during the operation of politeness rules **504** appropriately is that when there is a trade-off between technical accuracy and comprehensibility, voice user interface with personality **103** should choose the latter. Yet another social-psychology empirical observation that can be implemented by politeness rules **504** and executed during the operation of politeness rules **504** appropriately is that human beings generally speak using varied responses (e.g., phrases) while interacting in a dialog with another human being, and thus, politeness rules **504** include a rule for selecting varied responses (e.g., randomly select among multiple recorded prompts available for a particular response) for output by voice user interface software **102**.

FIG. **8** is a flow diagram of the operation of multiple voices rules **506** of personality engine **104** of FIG. **5** in accordance with one embodiment of the present invention. Multiple voices rules **506** include rules that are based on the following social-psychology theories: different voices should be different social actors, disfluencies in speech are noticed, and disfluencies make the speakers seem less intelligent. Accordingly, FIG. **8** is a flow diagram of the operation of multiple voices rules **506** that implement these social-psychology theories in accordance with one embodiment of the present invention.

At stage **802**, it is determined whether two voices are needed by voice user interface with personality **103** while interacting with a user. If two voices are desired, then operation proceeds to stage **804**.

At stage **804**, a smooth hand-off prompt is selected, which provides a smooth hand-off between the two voices to be used while interacting with the user. For example, a smooth hand-off is provided between the recorded voice output by the recorded speech software and the synthesized voice output by the TTS software. For example, voice user interface with personality **103** outputs "I will have your email read to you" to provide a transition between the recorded voice of recorded speech software **411** and the synthesized voice of TTS software **411**. This smooth hand-off rule is based on a social-psychology empirical observation that there should be a smooth transition from one voice to another.

At stage **806**, prompts are selected for output by each voice such that each voice utters an independent sentence. For each voice, an appropriate prompt is selected that is an independent sentence, and each voice then utters the selected prompt, respectively. For example, rather than outputting "[voice 1] Your email says [voice 2] ", voice user interface with personality **103** outputs "I will have your email read to you" using the recorded voice of recorded speech software **411**, and voice user interface with personality **103** outputs "Your current email says . . . " using the synthesized voice of TTS software **411**. This independent sentences rule is based on a social-psychology empirical observation that two different voices should not utter different parts of the same sentence.

The personality engine can also implement various rules for a voice user interface with personality to invoke elements of team affiliation. For example, voice user interface with personality **103** can invoke team affiliation by outputting recorded prompts that use pronouns such as "we" rather than "you" or "I" when referring to tasks to be performed or when referring to problems during operation of the system. This concept of team affiliation is based on social-psychology empirical observations that indicate that a user of a system is more likely to enjoy and prefer using the system if the user feels a team affiliation with the system. For example, providing a voice user interface with personality that invokes team affiliation is useful and advantageous for a subscriber service, in which the users are subscribers of a system that provides various services, such as the system discussed below with respect to FIG. **9**. Thus, a subscriber will likely be more forgiving and understanding of possible problems that may arise during use of the system, and hence, more likely to continue to be a subscriber of the service if the subscriber enjoys using the system through in part a team affiliation with the voice user interface with personality of the system.

The above discussed social-psychology empirical observations are further discussed and supported in The Media Equation, written by Byron Reeves and Clifford Nass, and published by CSLI Publications (1996).

A Voice User Interface with Personality for an Application

FIG. **9** is a block diagram of a voice user interface with personality for an application in accordance with one embodiment of the present invention. System **900** includes a voice user interface with personality **103** shown in greater detail in accordance with one embodiment of the present invention. System **900** includes an application **902** that interfaces with voice user interface with personality **103**.

Voice user interface with personality **103** can be stored in a memory of system **900**. Voice user interface with personality **103** provides the user interface for application **902** executing on system **900** and interacts with users (e.g., subscribers and contacts of the subscribers) of a service provided by system **900** via input data signals **904** and output data signals **906**.

Voice user interface with personality **103** represents a runtime version of voice user interface with personality **103** that is executing on system **900** for a particular user (e.g., a subscriber or a contact of the subscriber). Voice user interface with personality **103** receives input data signals **904** that include speech signals, which correspond to commands from a user, such as a subscriber. The voice user interface with personality recognizes the speech signals using a phrase delimiter **908**, a recognizer **910**, a recognition manager **912**, a recognition grammar **914**, and a recognition history **916**. Recognition grammar **914** is installed using a recognition grammar repository **920**, which is maintained by application **902** for all subscribers of system **900**. Recognition history **916** is installed or uninstalled using a recognition history repository **918**, which is maintained by application **902** for all of the subscribers of system **900**. Input data signals **904** are received at phrase delimiter **908** and then transmitted to rec-

ognizer **910**. Recognizer **910** extracts speech signals from input data signals **904** and transmits the speech signals to recognition manager **912**. Recognition manager **912** uses recognition grammar **914** and recognition history **916** to recognize a command that corresponds to the speech signals. The recognized command is transmitted to application **902**.

Voice user interface with personality **103** outputs data signals that include voice signals, which correspond to greetings and responses to the subscriber. The voice user interface with personality generates the voice signals using a player & synthesizer **922**, a prompt manager **924**, a pronunciation generator **926**, a prompt suite **928**, and a prompt history **930**. Prompt suite **928** is installed using a prompt suite repository **932**, which is maintained by application **902** for all of the subscribers of system **900**. Prompt history **930** is installed or uninstalled using a prompt history repository **934**, which is maintained by application **902** for all of the subscribers of system **900**. Application **902** transmits a request to prompt manager **924** for a generic prompt to be output to the subscriber. Prompt manager **924** determines the interaction state using interaction state **936**. Prompt manager **924** then selects a specific prompt (e.g., one of multiple prompts that correspond to the generic prompt) from a prompt suite **928** based on a prompt history stored in prompt history **930**. Prompt manager **924** transmits the selected prompt to player and synthesizer **922**. Player and synthesizer plays a recorded prompt or synthesizes the selected prompt for output via output data signals **906** to the subscriber.

The voice user interface with personality also includes a barge-in detector **938**. Barge-in detector **938** disables output data signals **906** when input data signals **904** are detected.

For example, recognition grammar **914** includes the phrases that result from the scripting and recording of dialog for a virtual assistant with a particular personality. A phrase is anything that a user can say to the virtual assistant that the virtual assistant will recognize as a valid request or response. The grammar organizes the phrases into contexts or domains to reflect that the phrases the virtual assistant recognizes may depend upon the state of the user's interactions with the virtual assistant. Each phrase has both a specific name and a generic name. Two or more phrases (e.g., "Yes" and "Sure") can share the same generic name but not the same specific name. All recognition grammars define the same generic names but not necessarily the same specific names. Two recognition grammars can include different numbers of phrases and so define different numbers of specific names.

While a recognition grammar is created largely at design time, at run-time the application can customize the recognition grammar for the subscriber (e.g., with the proper names of his or her contacts). Pronunciation generator **926** allows for custom pronunciations for custom phrases and, thus, a subscriber-specific grammar. For example, pronunciation generator **926** is commercially available from Nuance Corporation of Menlo Park, Calif.

Recognition history **916** maintains the subscriber's experience with a particular recognition grammar. Recognition history **916** includes the generic and specific names of the phrases in the recognition grammar and the number of times the voice user interface with personality has heard the user say each phrase.

In one embodiment, application **902** allows the subscriber to select a virtual assistant that provides a voice user interface with a particular personality and which includes a particular recognition grammar. Application **902** preserves the selection in a non-volatile memory. To initialize the virtual assistant for a session with the subscriber or one of the subscriber's contacts, application **902** installs the appropriate recognition grammar **914**. When initializing the virtual assistant, application **902** also installs the subscriber's recognition history **916**. For the subscriber's first session, an empty history is installed. At the end of each session with the subscriber, application **902** uninstalls and preserves the updated history, recognition history **916**.

The voice user interface with personality recognizes input data signals **904**, which involves recognizing the subscriber's utterance as one of the phrases stored in recognition grammar **914**, and updating recognition history **916** and interaction state **93**G accordingly. The voice user interface with personality returns the generic and specific names of the recognized phrase.

In deciding what the subscriber says, the voice user interface with personality considers not only recognition grammar **914**, but also both recognition history **916**, which stores the phrases that the subscriber has previously stated to the virtual assistant, and prompt history **930**, which stores the prompts that the virtual assistant previously stated to the subscriber.

Prompt suite **928** includes the prompts that result from the scripting and recording of a virtual assistant with a particular personality. A prompt is anything that the virtual assistant can say to the subscriber. Prompt suite **928** includes synthetic as well as recorded prompts. A recorded prompt is a recording of a human voice saying the prompt, which is output using player and synthesizer **922**. A synthetic prompt is a written script for which a voice is synthesized when the prompt is output using player and synthesizer **922**. A synthetic prompt has zero or more formal parameters for which actual parameters are substituted when the prompt is played For example, to announce the time, application **902** plays "It's now <time>", supplying the current time. The script and its actual parameters may give pronunciations for the words included in the prompt. Prompt suite **928** may be designed so that a user attributes the recorded prompts and synthetic prompts (also referred to as speech markup) to different personae (e.g., the virtual assistant and her helper, respectively). Each prompt includes both a specific name (e.g., a specific prompt) and a generic name (e.g., a specific prompt corresponds to a generic prompt, and several different specific prompts can correspond to the generic prompt). Two or more prompts (e.g., "Yes" and "Sure") can share the same generic name but not the same specific name. All suites define the same generic names but not necessarily the same specific names. Two prompt suites can include different numbers of prompts and, thus, define different numbers of specific names.

For example, prompt suite **928** includes the virtual assistant's responses to the subscriber's explicit coaching requests. These prompts share a generic name. There is one prompt for each possible state of the virtual assistant's interaction with the user.

Although prompt suite **928** is created at design time, at run-time application **902** can customize prompt suite **928** for the subscriber (e.g., with the proper names of the subscriber's contacts using pronunciation generator **926** to generate pronunciations for custom synthetic prompts). Thus, prompt suite **928** is subscriber-specific.

Prompt history **930** documents the subscriber's experience with a particular prompt suite. Prompt history **930** includes the generic and specific names of the prompts stored in prompt suite **928** and how often the voice user interface with personality has played each prompt for the subscriber.

In one embodiment, application **902** allows the subscriber to select a virtual assistant and, thus, a voice user interface with a particular personality that uses a particular prompt suite. Application **902** preserves the selection in non-volatile memory. To initialize the selected virtual assistant for a ses-

sion with the subscriber or a contact of the subscriber, application **902** installs the appropriate prompt suite. When initializing the virtual assistant, application **902** also installs the subscriber's prompt history **930**. For the subscriber's first session, application **902** installs an empty history. At the end of each session, application **902** uninstalls and preserves the updated history.

Application **902** can request that the voice user interface with personality play for the user a generic prompt in prompt suite **928**. The voice user interface with personality selects a specific prompt that corresponds to the generic prompt in one of several ways, some of which require a clock (not shown in FIG. **9**) or a random number generator (not shown in FIG. **9**), and updates prompt history **930** accordingly. For example, application **902** requests that the voice user interface with personality play a prompt that has a generic name (e.g., context-sensitive coaching responses), or application **902** requests that the voice user interface with personality play a prompt that has a particular generic name (e.g., that of an affirmation). In selecting a specific prompt that corresponds to the generic prompt, the voice user interface with personality considers both prompt history **930** (i.e., what the virtual assistant has said to the subscriber) and recognition history **916** (what the user has said to the virtual assistant). In selecting a specific prompt, the voice user interface with personality selects at random (e.g., to provided varied responses) one of two or more equally favored specific prompts.

Prompt suite **928** includes two or more greetings (e.g., "Hello", "Good Morning", and "Good Evening"). The greetings share a particular generic name. Application **902** can request that the voice user interface with personality play one of the prompts with the generic name for the greetings. The voice user interface with personality selects among the greetings appropriate for the current time of day (e.g., as it would when playing a generic prompt).

Prompt suite **928** includes farewells (e.g., "Good-bye" and "Good night"). The farewell prompts share a particular generic name. Application can request that the voice user interface with personality play one of the prompts with the generic name for the farewells. The voice user interface with personality selects among the farewells appropriate for the current time of day.

Application **902** can request that the voice user interface with personality play a prompt that has a particular generic name (e.g., a help message for a particular situation) and to select a prompt that is longer in duration than the previously played prompts. In selecting the longer prompt, the voice user interface with personality consults prompt history **930**.

Application **902** can request that the voice user interface with personality play a prompt that has a particular generic name (e.g., a request for information from the user) and to select a prompt that is shorter in duration than the previously played prompts. In selecting the shorter prompt, the voice user interface with personality consults prompt history **930**.

Application **902** can request that the voice user interface with personality play a prompt (e.g., a joke) at a particular probability and, thus, the voice user interface with personality sometimes plays nothing.

Application **902** can request that the voice user interface with personality play a prompt (e.g., a remark that the subscriber may infer as critical) at reduced volume.

Application **902** can request that the voice user interface with personality play an approximation prompt. An approximation prompt is a prompt output by the virtual assistant so that the virtual assistant is understood by the subscriber, at the possible expense of precision. For example, an approximation prompt for the current time of day can approximate the current time to the nearest quarter of an hour such that the virtual assistant, for example, informs the subscriber that the current time is "A quarter past four P.M." rather than overwhelming the user with the exact detailed time of "4:11:02 PM".

In one embodiment, application **902** provides various functionality including an email service, a stock quote service, a news content service, and a voice mail service. Subscribers access a service provided by system **900** via telephones or modems (e.g., using telephones, mobile phones, PDAs, or a standard computer executing a WWW browser such as the commercially available Netscape NAVIGATOR™ browser). System **900** allows subscribers via telephones to collect messages from multiple voice mail systems, scan voice messages, and manipulate voice messages (e.g., delete, save, skip, and forward). System **900** also allows subscribers via telephones to receive notification of email messages, scan email messages, read email messages, respond to email messages, and compose email messages. System **900** allows subscribers via telephones to setup a calendar, make appointments and to-do lists using a calendar, add contacts to an address book, find a contact in an address book, call a contact in an address book, schedule a new appointment in a calendar, search for appointments, act upon a found appointment, edit to-do lists, read to-do lists, and act upon to-do lists. System **900** allows subscribers via telephones to access various WWW content. System **900** allows subscribers to access various stock quotes. Subscribers can also customize the various news content, email content, voice mail content, and WWW content that system **900** provides to the subscriber. The functionality of application **902** of system **900** is discussed in detail in the product requirements document of microfiche Appendix C in accordance with one embodiment of the present invention.

System **900** advantageously includes a voice user interface with personality that acts as a virtual assistant to a subscriber of the service. For example, the subscriber can customize the voice user interface with personality to access and act upon the subscriber's voice mail, email, faxes, pages, personal information manager (PIM), and calendar (CAL) information through both a telephone and a WWW browser (e.g., the voice user interface with personality is accessible via the subscriber's mobile phone or telephone by dialing a designated phone number to access the service).

In one embodiment, the subscriber selects from several different personalities when selecting a virtual assistant. For example, the subscriber can interview virtual assistants with different personalities in order to choose the voice user interface with a personality that is best suited for the subscriber's needs, business, or the subscriber's own personality. A subscriber who is in a sales field may want an aggressive voice user interface with personality that puts incoming calls through, but a subscriber who is an executive may want a voice user interface with personality that takes more of an active role in screening calls and only putting through important calls during business hours. Thus, the subscriber can select a voice user interface with a particular personality.

As discussed above, to further the perception of true human interaction, the virtual assistant responds with different greetings, phrases, and confirmations just as a human assistant. For example, some of these different greetings are related to a time of day (e.g., "good morning" or "good evening"). Various humorous interactions are included to add to the personality of the voice user interface, as further discussed below. There are also different modes for the voice user interface with personality throughout the service. These different modes of operation are based on a social-psychology empirical observation that while some people like to drive, others

prefer to be driven. Accordingly, subscribers can have the option of easily switching from a more verbose learning mode to an accelerated mode that provides only the minimum prompts required to complete an action. A virtual assistant that can be provided as a voice user interface with personality for system **900** is discussed in detail in microfiche Appendix D in accordance with one embodiment of the present invention.

Dialog

FIG. **10** is a functional diagram of a dialog interaction between a voice user interface with personality **1002** (e.g., voice user interface with personality **103**) and a subscriber **1004** in accordance with one embodiment of the present invention. When subscriber **1004** logs onto a system that includes voice user interface with personality **1002**, such as system **900**, voice user interface with personality **1002** provides a greeting **1006** to subscriber **1004**. For example, greeting **1006** can be a prompt that is selected based on the current time of day.

Voice user interface with personality **1002** then interacts with subscriber **1004** using a dialog **1008**, which gives subscriber **1004** the impression that the voice user interface of the system has a personality.

If subscriber **1004** selects a particular command provided by the system such as by speaking a command that is within the recognition grammar of voice user interface with personality **1002**, then the system executes the command selection as shown at execute operation **1010**.

Before subscriber **1004** logs off of the system, voice user interface with personality **1002** provides a farewell **1012** to subscriber **1004**. For example, farewell **1012** can be a prompt that is selected based on the current time of day.

FIG. **11** is a flow diagram of the operation of voice user interface with personality **1002** of FIG. **10** during an interaction with a subscriber in accordance with one embodiment of the present invention. At stage **1102**, voice user interface with personality **1002** determines whether a recorded prompt needs to be output to the subscriber. If so, operation proceeds to stage **1104**.

At stage **1104**, voice user interface with personality **1002** determines whether there is a problem (e.g., the user is requesting to access email, and the email server of the system is down, and thus, unavailable). If so, operation proceeds to stage **1106**. Otherwise, operation proceeds to stage **1108**. At stage **1106**, voice user interface with personality **1002** executes negative comments rules (e.g., negative comments rules **502**).

At stage **1108**, voice user interface with personality **1002** determines whether multiple voices are required at this stage of operation during interaction with the subscriber (e.g., the subscriber is requesting that an email message be read to the subscriber, and TTS software **411** uses a synthesized voice to read the text of the email message, which is a different voice than the recorded voice of recorded speech software **411**). If so, operation proceeds to stage **1110**. Otherwise, operation proceeds to stage **1112**. At stage **1110**, voice user interface with personality **1002** executes multiple voices rules (e.g., multiple voices rules **506**).

At stage **1112**, voice user interface with personality **1002** executes politeness rules (e.g., multiple voices rules **504**). At stage **1114**, voice user interface with personality **1002** executes expert/novice rules (e.g., expert/novice rules **508**). At stage **1116**, voice user interface with personality **1002** outputs the selected prompt based on the execution of the appropriate rules.

As discussed above with respect to FIG. **9**, system **900** includes functionality such as calendar functionality that, for example, allows a subscriber of system **900** to maintain a calendar of appointments. In particular, the subscriber can modify an appointment previously scheduled for the subscriber's calendar.

FIG. **12** provides a command specification of a modify appointment command for system **900** in accordance with one embodiment of the present invention. FIG. **12** shows the command syntax of the modify appointment command, which is discussed above. For example, a subscriber can command voice user interface with personality **1002** (e.g., the subscriber command the application through voice user interface with personality **1002**) to modify an appointment by stating, "modify an appointment on June 13 at 3 p.m." The command syntax of FIG. **12** provides a parse of the modify appointment command as follows: "modify" represents the command, "appointment" represents the object of the command, "date" represents option1 of the command, and "time" represents option2 of the command. The subscriber can interact with voice user interface with personality **1002** using a dialog to provide a command to the system to modify an appointment.

FIGS. **13**A and **13**B are a flow diagram of a dialog for a modify appointment command between voice user interface with personality **1002** and a subscriber in accordance with one embodiment of the present invention. The dialog for the modify appointment command implements the rules that provide a voice user interface with personality, as discussed above (e.g., negative comments rules **502**, politeness rules **504**, multiple voices rules **506**, and expert/novice rules **508** of personality engine **104**).

Referring to FIG. **13**A, at stage **1302**, voice user interface with personality **1002** recognizes a modify appointment command spoken by a subscriber. At stage **1304**, voice user interface with personality **1002** confirms with the subscriber an appointment time to be changed.

At stage **1306**, voice user interface with personality **1002** determines whether the confirmed appointment time to be changed represents the right appointment to be modified. If so, operation proceeds to stage **1312**. Otherwise, operation proceeds to stage **1308**. At stage **1308**, voice user interface with personality **1002** informs the subscriber that voice user interface with personality **1002** needs the correct appointment to be modified, in other words, voice user interface with personality **1002** needs to determine the start time of the appointment to be modified. At stage **1310**, voice user interface with personality **1002** determines the start time of the appointment to be modified (e.g., by asking the subscriber for the start time of the appointment to be modified).

At stage **1312**, voice user interface with personality **1002** determines what parameters to modify of the appointment. At stage **1314**, voice user interface with personality **1002** determines whether the appointment is to be deleted. If so, operation proceeds to stage **1316**, and the appointment is deleted. Otherwise, operation proceeds to stage **1318**. At stage **1318**, voice user interface with personality **1002** determines whether a new date is needed, in other words, to change the date of the appointment to be modified. If so, operation proceeds to stage **1320**, and the date of the appointment is modified. Otherwise, operation proceeds to stage **1322**. At stage **1322**, voice user interface with personality **1002** determines whether a new start time is needed. If so, operation proceeds to stage **1324**, and the start time of the appointment is modified. Otherwise, operation proceeds to stage **1326**. At stage **1326**, voice user interface with personality **1002** determines whether a new duration of the appointment is needed. If so, operation proceeds to stage **1328**, and the duration of the appointment is modified. Otherwise, operation proceeds to

stage **1330**. At stage **1330**, voice user interface with personality **1002** determines whether a new invitee name is needed. If so, operation proceeds to stage **1332**. Otherwise, operation proceeds to stage **1334**. At stage **1332**, voice user interface with personality **1002** determines the new invitee name of the appointment.

Referring to FIG. **13**B, at stage **1336**, voice user interface with personality **1002** determines whether it needs to try the name again of the invitee to be modified. If so, operation proceeds to stage **1338** to determine the name of the invitee to be modified. Otherwise, operation proceeds to stage **1340**. At stage **1340**, voice user interface with personality **1002** confirms the name of the invitee to be modified. At stage **1342**, the invitee name is modified.

At stage **1334**, voice user interface with personality **1002** determines whether a new event description is desired by the subscriber. If so, operation proceeds to stage **1344**, and the event description of the appointment is modified appropriately. Otherwise, operation proceeds to stage **1346**. At stage **1346**, voice user interface with personality **1002** determines whether a new reminder status is desired by the subscriber. If so, operation proceeds to stage **1348**, and the reminder status of the appointment is modified appropriately.

A detailed dialog for the modify appointment command for voice user interface with personality **1002** is provided in detail in Appendix A in accordance with one embodiment of the present invention. FIG. **14** shows an excerpt of Appendix A of the dialog for the modify appointment command of voice user interface with personality **1002**. As shown in FIG. **14**, the dialog for the modify appointment command is advantageously organized and arranged in four columns. The first column (left-most column) represents the label column, which represents a label for levels within a flow of control hierarchy during execution of voice user interface with personality **1002**. The second column (second left-most column) represents the column that indicates what the user says as recognized by voice user interface with personality **1002** (e.g., within the recognition grammar of voice user interface with personality **1002**, as discussed below). The third column (third left-most column) represents the flow control column. The flow control column indicates the flow of control for the modify appointment command as executed by voice user interface with personality **1002** in response to commands and responses by the subscriber and any problems that may arise during the dialog for the modify appointment command. The fourth column (right-most column) represents what voice user interface with personality **1002** says (e.g., recorded prompts output) to the subscriber during the modify appointment dialog in its various stages of flow control.

As shown in FIG. **14** (and further shown in Appendix A), the fourth column provides the dialog as particularly output by voice user interface with personality **1002**. FIG. **14** also shows that voice user interface with personality **1002** has several options at various stages for prompts to play back to the subscriber. The dialog for the modify appointment command as shown in FIG. **14** and further shown in Appendix A is selected according to the rules that provide a voice user interface with personality, as discussed above. The four-column arrangement shown in FIG. **14** also advantageously allows for the generation of dialogs for various commands of a system, such as system **900**, that can then easily be programmed by a computer programmer to implement voice user interface with personality **1002**.

Script the Dialog

Based on the functional specification of a system such as system **900**, a dialog such as the dialog specification discussed above, and in particular, a set of rules that define a voice user interface with personality such as the rules executed by personality engine **104**, scripts are written for the dialog executed by voice user interface with personality **1002**.

FIG. **15** shows scripts written for a mail domain (e.g., voice mail functionality) of application **902** of system **900** in accordance with one embodiment of the present invention. The left column of the table of FIG. **15** indicates the location of the flow of control of operation of voice user interface with personality **1002** within a particular domain (in this case the mail domain), in which the domains and flow of control of operation within domains are particularly specified in a finite state machine, as further discussed below.

Thus, within the mail domain, and within the mail top navlist stage of flow control, voice user interface with personality **1002** can state any of seven prompts listed in the corresponding right column. For example, voice user interface with personality **1002** can select the first listed prompt and, thus, output to the subscriber, "What do you want me to do with your mail?". Voice user interface with personality **1002** can select the third listed prompt and then say to the subscriber, "Okay, mail's ready. How can I help you?". Or, voice user interface with personality **1002** can select the fifth listed prompt and, thus, output to the subscriber, "What would you like me to do?".

The various prompts selected by voice user interface with personality **1002** obey the personality specification, as described above. For example, voice user interface with personality **1002** can select among various prompts for the different stages of flow control within a particular domain using personality engine **104**, and in particular, using negative comments rules **502**, politeness rules **504**, multiple voices rules **506**, and expert/novice rules **508**.

Varying the selection of various prompts within a session and across sessions for a particular subscriber advantageously provides a more human-like dialog between voice user interface with personality **1002** and the subscriber. Selection of various prompts can also be driven in part by a subscriber's selected personality type for voice user interface with personality **1002**. For example, if the subscriber prefers a voice user interface with personality **1002** that lets the subscriber drive the use of system **900** (e.g., the subscriber has a driver type of personality), then voice user interface with personality **1002** can be configured to provide a friendly-submissive personality and to select prompts accordingly.

Voice user interface with personality **1002** can also use dialogs that include other types of mannerisms and cues that provide the voice user interface with personality, such as laughing to overcome an embarrassing or difficult situation. For example, within the mail domain and the gu_mail_reply_recipient stage of flow control, the last listed prompt is as follows, "<Chuckle> This isn't going well, is it? Let's start over."

The prompts of application **902** are provided in microfiche Appendix E in accordance with one embodiment of the present invention.

The process of generating scripts can be performed by various commercially available services. For example, FunArts Software, Inc. of San Francisco, Calif., can write the scripts, which inject personality into each utterance of voice user interface with personality **1002**.

Record the Dialog

After writing the scripts for the dialog of voice user interface with personality **1002**, the scripts are recorded and stored (e.g., in a standard digital format) in a memory such as memory **101**). In one embodiment, a process of recording scripts involves directing voice talent, such as an actor or

actress, to generate interactive media, such as the dialogs for voice user interface with personality **1002**.

First, an actor or actress is selected to read the appropriate scripts for a particular personality of voice user interface with personality **1002**. The actor or actress is selected based upon their voice and their style of delivery. Then, using different timbres and pitch ranges that the actor or actress has available, a character voice for voice user interface with personality **1002** is generated and selected for each personality type. Those skilled in the art of directing voice talent will recognize that some of the variables to work with at this point include timbre, pitch, pace, pronunciation, and intonation. There is also an overall task of maintaining consistency within the personality after selecting the appropriate character voice.

Second, the scripts are recorded. Each utterance (e.g., prompt that can be output by voice user interface with personality **1002** to the subscriber) can be recorded a number of different times with different reads by the selected actor or actress. The director maintains a detailed and clear image of the personality in his or her mind in order to keep the selected actor or actress "in character". Accordingly, maintaining a sense of the utterances within all the possible flow of control options is another important factor to consider when directing non-linear interactive media, such as the recording of scripts for voice user interface with personality **1002**. For example, unlike narrative, non-linear interactive media, such as the dialog for voice user interface with personality **1002**, does not necessarily have a predefined and certain path. Instead, each utterance works with a variety of potential pathways. User events can be unpredictable, yet the dialog spoken by voice user interface with personality **1002** should make sense at all times, as discussed above with respect to FIG. **7**.

A certain degree of flexibility and improvisation in the recording process may also be desirable as will be apparent to those skilled in the art of generating non-linear interactive media. However, this is a matter of preference for the director. Sometimes the script for an utterance can be difficult to pronounce or deliver in character and can benefit from a spur of the moment improvisation by the actor or actress. Often the short, character-driven responses that surround an utterance such as a confirmation can respond to the natural sounds of the specific actor. Creating and maintaining the "right" feeling for the actor is also important during the recording of non-linear media. Because the actor or actress is working in total isolation, without the benefit of other actors or actresses to bounce off of, or a coherent story line, and the actor or actress is often reading from an unavoidably technical script, it is important that the director maintain a close rapport with the selected actor or actress during recording and maintain an appropriate energy level during the recording process.

FIG. **16** is a flow diagram for selecting and executing a prompt by voice user interface with personality **1002** in accordance with one embodiment of the present invention. At stage **1602**, voice user interface with personality **1002** determines whether or not a prompt is needed. If so, operation proceeds to stage **1604**. At stage **1604**, application **902** requests that voice user interface with personality outputs a generic prompt (e.g., provides a generic name of a prompt).

At stage **1606**, voice user interface with personality **1002** selects an appropriate specific prompt (e.g., a specific name of a prompt that corresponds to the generic name). A specific prompt can be stored in a memory, such as memory **101**, as a recorded prompt in which different recordings of the same prompt represent different personalities. For example, voice user interface with personality **1002** uses a rules-based engine such as personality engine **104** to select an appropriate specific prompt. The selection of an appropriate specific prompt can be based on various factors, which can be specific to a particular subscriber, such as the personality type of voice user interface with personality **1002** configured for the subscriber and the subscriber's expertise with using voice user interface with personality **1002**. At stage **1608**, voice user interface with personality outputs the selected specific prompt to the subscriber.

FIG. **17** is a block diagram of a memory **1700** that stores recorded scripts in accordance with one embodiment of the present invention. Memory **1700** stores recorded scripts for the mail domain scripts of FIG. **15**, and in particular, for the stage of flow of control of mail_top_navlist for various personality types, as discussed above. Memory **1700** stores recorded mail_top_navlist scripts **1702** for a friendly-dominant personality, recorded mail_top_navlist scripts **1704** for a friendly-submissive personality, recorded mail_top navlist scripts **1706** for an unfriendly-dominant personality, and recorded mail_top_navlist scripts **1708** for an unfriendly-submissive personality.

In one embodiment, recorded mail_top_navlist scripts **1702**, **1704**, **1706**, and **1708** can be stored within personality engine **104** (e.g., in prompt suite **928**). Personality engine **104** selects an appropriate recorded prompt among recorded mail_top_navlist scripts **1702**, **1704**, **1706**, and **1708**. The selection of recorded mail top_navlist scripts **1702**, **1704**, **1706**, and **1708** by personality engine **104** can be based on the selected (e.g., configured) personality for voice user interface with personality **1002** for a particular subscriber and based on previously selected prompts for the subscriber within a current session and across sessions (e.g., prompt history **930**). For example, personality engine **104** can be executed on computer system **100** and during operation of the execution perform such operations as select prompt operation **1604** and select recorded prompt operation **1606**.

The process of recording scripts can be performed by various commercially available services. For example, FunArts Software, Inc. of San Francisco, Calif., writes scripts, directs voice talent in reading the scripts, and edits the audio tapes of the recorded scripts (e.g., to adjust volume and ensure smooth audio transitions within dialogs).

Finite State Machine Implementation

Based upon the application of a system, a finite state machine implementation of a voice user interface with personality is generated. A finite state machine is generated in view of an application, such as application **902** of system **900**, and in view of a dialog, such as dialog **1008** as discussed above. For a computer-implemented voice user interface with personality, the finite state machine implementation should be generated in a manner that is technically feasible and practical for coding (programming).

FIG. **18** is a finite state machine diagram of voice user interface with personality **1002** in accordance with one embodiment of the present invention. Execution of the finite state machine begins at a login and password state **1810** when a subscriber logs onto system **900**. After a successful logon, voice user interface with personality **1002** transitions to a main state **1800**. Main state **1800** includes a time-out handler state **1880** for time-out situations (e.g., a user has not provided a response within a predetermined period of time), a take-a-break state **1890** (e.g., for pausing), and a select domain state **1820**.

From select domain state **1820**, voice user interface with personality **1002** determines which domain of functionality to proceed to next based upon a dialog (e.g., dialog **1008**) with a subscriber. For example, the subscriber may desire to record a name, in which case, voice user interface with personality **1002** can transition to a record name state **1830**. When execut-

ing record name state **1830**, voice user interface with personality **1002** transitions to a record name confirm state **1840** to confirm the recorded name. If the subscriber desires to update a schedule, then voice user interface with personality **1002** can transition to an update schedule state **1850**. From update schedule state **1850**, voice user interface with personality **1002** transitions to an update schedule confirm state **1860** to confirm the update of the schedule. The subscriber can also request that voice user interface with personality **1002** read a schedule, in which case, voice user interface with personality **1002** transitions to a read schedule state **1870** to have voice user interface with personality **1002** have a schedule read to the subscriber.

A finite state machine of voice user interface with personality **1002** for application **902** of system **900** is represented as hyper text (an HTML listing) in microfiche Appendix F in accordance with one embodiment of the present invention.

Recognition Grammar

Voice user interface with personality **1002** includes various recognition grammars that represent the verbal commands (e.g., phrases) that voice user interface with personality **1002** can recognize when spoken-by a subscriber. As discussed above, a recognition grammar definition represents a trade-off between accuracy and performance as well as other possible factors. It will be apparent to one of ordinary skill in the art of ASR technology that the process of defining various recognition grammars is usually an iterative process based on use and performance of a system, such as system **900**, and voice user interface with personality **1002**.

FIG. **19** is a flow diagram of the operation of voice user interface with personality **1002** using a recognition grammar in accordance with one embodiment of the present invention. At stage **1902**, voice user interface with personality **1002** determines whether or not a subscriber has issued (e.g., spoken) a verbal command. If so, operation proceeds to stage **1904**. At stage **1904**, voice user interface with personality **1002** compares the spoken command to the recognition grammar.

At stage **1906**, voice user interface with personality **1002** determines whether there is a match between the verbal command spoken by the subscriber and a grammar recognized by voice user interface with personality **1002**. If so, operation proceeds to stage **1908**, and the recognized command is executed.

In one embodiment, at stage **1904**, voice user interface with personality **1002** use the recognition grammar to interpret the spoken command and, thus, combines stages **1904** and **1906**.

Otherwise, operation proceeds to stage **1910**. At stage **1910**, voice user interface with personality **1002** requests more information from the subscriber politely (e.g., executing politeness rules **504**).

At stage **1912**, voice user interface with personality **1002** determines whether or not there is a match between a recognition grammar and the verbal command spoken by the subscriber. If so, operation proceeds to stage **1908**, and the recognized command is executed.

Otherwise, operation proceeds to stage **1914**. At stage **1914**, voice user interface with personality **1002** requests that the subscriber select among various listed command options that are provided at this point in the stage of flow of control of a particular domain of system **900**. Operation then proceeds to stage **1908** and the selected command is executed.

A detailed recognition grammar for application **902** of system **900** is provided in microfiche Appendix G in accordance with one embodiment of the present invention.

Recognition grammars for a system such as system **900** can be defined in a grammar definition language (GDL) and the recognition grammars specified in GDL can then be automatically translated into machine executable grammars using commercially available software. For example, ASR software is commercially available from Nuance Corporation of Menlo Park, Calif.

Computer Code Implementation

Based on the finite state machine implementation, the selected personality, the dialog, and the recognition grammar (e.g., GDL), all discussed above, voice user interface with personality **1002** can be implemented in computer code that can be executed on a computer, such as computer system **100**, to provide a system, such as system **900**, with a voice user interface with personality, such as voice user interface with personality **1002**. For example, the computer code can be stored as source code or compiled and stored as executable code in a memory, such as memory **101**.

A "C" code implementation of voice user interface with personality **1002** for application **902** of system **900** is provided in detail in microfiche Appendix H in accordance with one embodiment of the present invention.

Accordingly, the present invention provides a voice user interface with personality. For example, the present invention can be used to provide a voice user interface with personality for a telephone system that provides various functionality and services, such as an email service, a news content service, a stock quote service, and a voice mail service. A system that includes a voice user interface or interacts with users via telephones or mobile phones would significantly benefit from the present invention.

Although particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the present invention in its broader aspects, and therefore, the appended claims are to encompass within their scope all such changes and modifications that fall within the true scope of the present invention.

What is claimed is:

1. A method comprising:

initiating, at one or more computing devices, a finite state machine;

receiving, at the one or more computing devices, a voice input;

interpreting, at the one or more computing devices, the received voice input, comprising:

transitioning to a domain state functionality of the finite state machine,

selecting a generic prompt corresponding to the domain state functionality, and

selecting a specific prompt corresponding to the generic prompt, wherein the specific prompt comprises a variant of the generic prompt and also corresponds to the domain state functionality; and

transmitting, at the one or more computing devices, the specific prompt in a response.

2. The method of claim **1**, wherein the voice input comprises a phonetic, short phrase input.

3. The method of claim **1**, wherein the domain state functionality comprises one or more of the set of voice mail, email, faxes, pages, personal information manager (PIM), calendar, and browser.

4. The method of claim **2**, further comprising:

recognizing the phonetic, short phrase input using a grammar definition language (GDL) that performs a function of speech recognition grammar.

5. The method of claim **2**, further comprising:

recognizing a specific name for the phonetic, short phrase; and

recognizing a generic name for the phonetic, short phrase, corresponding to the specific name, using a grammar definition language (GDL) that performs a function of speech recognition grammar.

6. The method of claim **2**, further comprising:

matching the phonetic, short phrase input to a phonetic, short phrase response corresponding to a recognition grammar.

7. The method of claim **6**, further comprising:

matching the phonetic, short phrase input using 'more like/less like' logic.

8. The method of claim **6**, further comprising:

matching the phonetic, short phrase input by dynamically updating a grammar library.

9. The method of claim **6**, further comprising:

parsing messages, constructing prompts, constructing grammar, and erasing previous grammar.

10. The method of claim **9**, further comprising:

matching the phonetic, short phrase input using user recognition logic.

11. The method of claim **6**, wherein the recognition grammar corresponds to a voice interface personality.

12. The method of claim **1**, wherein the generic prompt is defined for a plurality of prompt suites.

13. The method of claim **12**, wherein the specific prompt is defined for a corresponding particular prompt suite of the plurality of prompt suites.

14. The method of claim **1**, wherein the specific prompt is selected based on a configuration parameter.

15. The method of claim **14**, wherein the configuration parameter comprises a level of expertise.

16. An article of manufacture including a non-transitory computer-readable storage medium having stored hereon computer-executable instructions, execution of which, by a computing device, causes the computing device to perform operations for performing speech recognition, the operations comprising:

initiating a finite state machine;

receiving a voice input;

interpreting the received voice input, comprising:

transitioning to a domain state functionality of the finite state machine,

selecting a generic prompt corresponding to the domain state functionality, and

selecting a specific prompt corresponding to the generic prompt, wherein the specific prompt comprises a variant of the generic prompt and also corresponds to the domain state functionality; and

transmitting the specific prompt in a response.

17. A system of speech recognition, comprising an executable finite state machine programmed to:

initiate a finite state machine;

receive a voice input;

interpret the received voice input, comprising:

transitioning to a domain state functionality of the finite state machine,

selecting a generic prompt corresponding to the domain state functionality, and

selecting a specific prompt corresponding to the generic prompt, wherein the specific prompt comprises a variant of the generic prompt and also corresponds to the domain state functionality; and

transmit the specific prompt in a response.

18. A system comprising:

means for initiating a finite state machine;

means for receiving a voice input;

means for interpreting the received voice input, comprising:

means for transitioning to a domain state functionality of the finite state machine,

means for selecting a generic prompt corresponding to the domain state functionality, and

means for selecting a specific prompt corresponding to the generic prompt, wherein the specific prompt comprises a variant of the generic prompt and also corresponds to the domain state functionality; and

means for transmitting the specific prompt in a response.

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